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DEVELOPMENT OF A HEALTH SAFETY AND ENVIRONMENT (HSE) PERFORMANCE REVIEW METHODOLOGY FOR THE OIL AND GAS INDUSTRY IN LIBYA

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Abstract

Development of Health Safety and Environment (HSE) Performance Review Methodology for the Oil and Gas Industry in Libya

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Key words: Health, Safety, Environment, HSE, Performance, Assessment, Review, Empirical Research, Oil, Gas, Management Framework, Libya.

The oil and gas industry in Libya has suffered a number of health and safety accidents including environmental disasters due to the nature of the work involved and the hazardous materials it handles in all facets of exploration and production. Such issues have hitherto not received due attention by the Libyan Authorities. The fact that strict HSE assessment standards are neither well-defined nor established in Libya is not helpful. Furthermore, oil and gas industry in new free Libya has suffered immensely during the 2011 Arab Spring and its rebuilding poses a number of critical HSE challenges.

The purpose of the research is to develop and validate a HSE Performance Review Methodology for Libyan oil and gas industry based on clearly defined and measurable aspects for assessment. The thesis starts by performing a comprehensive literature review on all aspects of HSE including universal standards. The review indicates that there is a gap in respect of semi-qualitative methods for assessing HSE performance commensurate with other disciplines. The thesis then identifies four key research problems in the context of Libyan oil and gas industries. Based on these problems, an empirical research was conducted and included three distinct Stages.

Stage 1 consisted of a pilot study based on an interview questionnaire with 15 experienced HSE professionals working in oil and gas companies in Libya to help identify key issues pertaining to HSE assessment. Data analysis results for Stage 2 have been used to derive a list of 12 main groups of HSE questions which have then been tested on 84 HSE professionals working in Libya stemming from 35 medium and

large oil and gas companies. Modal distribution analyses have been performed to scope down the number of HSE performance factors, which would then be used in Stage 3 of the empirical research. This consisted of issuing the same 84 interviewees with a questionnaire requesting their assessment of how Critical, Important and Less Important were the 60 factors identified. Central Tendency, Variation Ratios and Indices of Diversity were used to successfully analyse the data.

With the QAA Subject Review in mind as a potential model for the sought methodology, and a mapping of the four research problems with data analysis results from Stages 1, 2 and 3; six HSE Performance Review Aspects emerged: Prevention, Surveillance, Response, Achievements, Resource and HSE Management and Enhancement – judged and graded using a 1 to 4 scale.

The HSE Performance Review methodology has been validated by direct application to five comprehensive studies starting from the self-assessment document written by the companies, an extensive review visit by peer-assessors and a final report showing grades, benchmarks and shortcomings. Lessons learned from the validation exercise have been used to revise the definition of the six Aspects and used to propose an appropriate implementation plan in Libya. The results of the validation exercise are very encouraging and readily confirm that the methodology can be applied to other industry sectors.

Contents

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List of Abbreviations

ACGIH	American Conference of Governmental Industrial Hygienists
APELL	Awareness and Preparedness for Emergencies at Local Levels
API	American petroleum Institute
ARI	Acute Respiratory Infections
ARMADA	Age Related Morbidity and Death Analysis
BS	British Standards institution
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CBD	Biodiversity Convention
CHASE	Complete Health and Safety Evaluation
COP	Conference of Parties
CRA	Comparative Risk Assessment
DALY	Disability Adjusted Life Years
DSS	Demographic Surveillance System
EBD	Environmental Burden of Disease
ECHP	European Centre for Health Policy
EGA	Environment General Authority
EIA	Environmental Impact Assessment
EP	Exploration and production
ESIA	Environmental Social Impact Assessment
FAR	Fatal accident Rate
GBD	Global Burden of Disease
GIS	Geographic Information System
GOR	Global Operative Regulations
HAOC	Health Area of Concern
HAP	Health Action Plan
HAZOP	Hazard and Operability Analysis
HDI	Human Development Index
HIA	Health Impact Assessment
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome

HSE	Health, Safety and Environment
HSEMS	Health, Safety and Environment Management System
HSIS	Hazardous Substance Information System
IO	Internal Olefins
IOC	International Oil Companies
ISA	International Safety Audit System
ISRS	International Safety Rating System
LAO	Linear Alpha Olefins
LNCSM	Libyan national Centre for Standardisation and Meteorology
LNG	Liquid Natural Gas
LP	Linear Paraffin
LPG	Liquid Petroleum Gas
LPI	Libyan Petroleum Institute
LSA	Low Specific Activity Scale Contamination
LTA	Lost Time Accidents
LTI	Lost Time Injuries
Mg/m3	Milligrams per cubic meter
NAF	Non-aqueous Fluids
NGO	Non-Governmental Organization
NIOSH	National Institute of Occupational Safety and Health, USA
NOC	Notational Oil Corporation
OEL	Occupational Exposure Limit
OGP	International Association of Oil and Gas Producers
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment System
OHSE	Occupational Health Safety and Environment
OIMP	Operations Integrity Management Practices
OPEC	Organization of Petroleum Export Countries
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbons
PAO	Poly-alpha Olefins
POHEM	Population Health Model
PPE	Personal Protective Equipment

Ppm	Parts Per Million
PRC	Petroleum Research Centre
PRM	Performance Review Methodology
PSM	Process Safety Management
QAA	Quality Assurance Agency for Higher Education
QALY	Quality Adjusted Life Years
ROP	Rate of Penetration (drilling)
RPE	Respiratory Protective Equipment
RS	Remote Sensing
SD	Sustainable Development
SHM	Strategic Health Management
SIA	Social Impact Assessment
SRM	Subject Review Methodology
SSS	Sentinel Surveillance System
STH	Soil Transmitted Helmets
STI	Sexually Transmitted Infection
TB	Tuberculosis
TLV	Threshold Limit Value
TOR	Terms of Reference
TPM	Total Preventive Maintenance
TRIR	Total Recordable Injury Rate
TWA	Time-weighted Average
UNEP	United Nations Environment Programme
USEPA	United States Environmental Protection Agency
VR	Variation Ratio
WBF	Water-based Fluid
WHO	World Health Organization

List of Definitions

Aerosols:	Suspension of variable size particles capable of remaining airborne.
Biological testing:	For the presence of a hazardous monitoring substance, its metabolites or a bio chemical change in a person's body tissue, exhaled air or fluid.
Carcinogenic:	Capable of causing cancer.
Chemical name:	The scientific or technical name of a substance.
Code of practice:	A systematic collection of rules, standards and other information relating to the practices and procedures followed in an area.
Control measures:	Ways of preventing or minimizing a person's exposure to a hazardous substance. A hierarchy of controls ranks measures taken to prevent or reduce hazard exposure according to effectiveness.
Corrosive:	Capable of destroying materials or living tissue (e.g. skin).
Dusts:	Caused by mechanical abrasion or fragmentation of solids, the size of particles is 0.1–100µm (microns).
Exposed:	A person is exposed to a hazardous substance if the person absorbs, or is likely to absorb the substance by ingestion or inhalation or through the skin or mucous membrane.
Gases:	Substances which normally exist in gaseous form at standard pressure and temperature.
Hazard:	The hazard presented by a substance is its potential to cause harm.
Hazardous:	Chemical or other substances that can substance affect workers health, causing illness or disease; and any substance for which the supplier, manufacturer or importer must provide a current material safety data sheet. Since September 1997, hazardous substances include those with carcinogenic, mutagenic and teratogenic effects,
Health:	The monitoring (including biological surveillance monitoring or medical examination) of a person in relation to the person's

	exposure to a hazardous substance.
Hierarchy	Ranking of measures taken to prevent or of controls reduce hazard exposure according to effectiveness. That is from the most effective measures that eliminate hazards to the least satisfactory that achieve only limited protection.
Smoke:	Suspension of solid particles produced by incomplete combustion of organic materials; size of particle usually less then 0.5mm and particles do not settle readily. Vapours Gaseous form substances normally liquid at standard pressure and temperature
Surveillance:	The purpose of identifying changes in health status due to exposure.

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Chapter 1: Introduction

1.1 Background

Libya is situated in North Africa bordered by Tunisia and Algeria in the west, the Mediterranean Sea in the north, Egypt in the east, and Niger, Chad and Sudan in the south. Libya accounts for a vast area of 1,759,540 square kilometres and has over 1,900 kilometres of coastline with the Mediterranean Sea to the north. Libya is the third in size among Africa's countries and fourteenth among the countries of the world. It is about one-half the size of Europe and one-quarter the size of the United States of America. Libya largely consists of barren rocky and sandy desert, which is part of the Sahara. Its strategic location in the middle of North Africa, along the Mediterranean Sea, makes it subject to several waves of military invasions including the Phoenicians, the Greeks and the Romans.

More than 80% of the area of Libya is desert and of the remainder a high percentage is used for grassing and only 13 percent is arable.

Since 1954, a census has been undertaken every ten years. The latest official census which was conducted in 2005 and recorded a population of 6,526,000 Libyan Secretariat of Economic and Planning Report of Ministry of Economic and Planning (2005), recording an overall population density of about 3 persons per square kilometre (about 8 per square mile). A map of Libya is shown in Figure 1.1

Over 86 percent of Libya's population resides along a thin strip on its 1,900 kilometres long Mediterranean coast, which also contains the country's most fertile land and accommodating its major industrial projects.

Figure 1.1: Map of Libya

The oil and gas industry 20-year depression, from 1985 to 2005, created a generation of risk-averse events. The risk factor today in this industry is about four times what it was 40 years ago. The situation is much worse in Libya as there are no third-party audits similar to the one for over 90% of the world's proven hydrocarbon reserves and no data on the same percentage of the most important Libyan oil and gas fields.

Worldwide HSE is treated as an integrated approach of management, leadership commitment and coordinated technical interventions from concept, commissioning to commercial operations. Occupational Health Safety and Environment (OHSE) professionals have a major role to play in preventing the potential causes of a disaster.

Current Libyan practices are based mostly on recording accidents as opposed to taking a proactive role in eliminating or reducing the occurrence of causes of disasters. While it is widely accepted that accident statistics play an important role as prime indicators of HSE protection system performance, statistics alone tell little about how accidents occur or about how to reduce the number of injuries. In addition, the methods used to record accident statistics in various countries vary. They may include Lost Time Injuries (LTI), Lost Time Accidents (LTA), and sometimes, but rarely, near misses. Unfortunately, only recorded incidents are considered in these statistics.

1.2 An appraisal of existing HSE guidelines

As per estimates of the World Energy Outlook (2008), the current oil production will dwindle from 85 million b/d to 25 million b/d by 2030 (NOC, 2009). To continue supplying 85 million b/d through to 2030 would require finding the equivalent of four new sites like Iran. Based on an Oil and Gas Producers (OGP) report, around 3.3 billion additional hours were spent by the producers in 2008 - that is a 13% increase over the previous years. During the reporting period, Lost Time Injury (LTI) frequency is the lowest on record at 0.55 injuries per million hours worked. The Total Recordable Injury Rate (TRIR) is also at an all-time low of 2.08 injuries per million hours worked – continuing a long-term trend for improvement. Having said this, the severity of incidents being reported is increasing. This is apparent from the Libyan Fatal Accident on 2002-7 period data as given in Figure 14 later in Chapter 3. The ratio of lost time injuries to fatalities is 6 to 10 in 2007. The most prevalent type of fatal incidents in oil and gas industry is verbally reported to be associated with vehicle operations, being struck by moving objects or falling victim due to not wearing seat belt.

According to (OGP, 2007), there is the volume of HSE reports from the Middle East that are rising to account for 25% of all hours worked. This shift shows a better trend in reporting in respect of the upstream safety performance as a whole. As per OGP, 103 people are reported to have died in 82 upstream-related incidents in 2007.

An overview of HSE system management in the early stage of oil and gas exploitation and production to support industrialisation shows that it was managed through training and following safe procedures, compliance with rules and regulations, etc. During the next stage of development, enhanced safety features were achieved through technological advances such as safe processes and safety features, which are built in due to statutory rules. In recent years, the HSE approach is based on lessons learnt from the (Cullen, 1991) on the Piper Alpha Disaster, which shows a greater emphasis on formal HSE protection management systems. The report demonstrates that an ideal HSE Management System must be based on an integrated approach of management, leadership commitment and coordinated technical interventions from concept and commissioning to commercial operations.

Like many other oil producing countries, Libyan oil and gas sector Exploration and Production activities too are subject to extensive legislation and regulation concerning Occupational HSE Protection (OHSE) System. All operators depending upon their country of origin claim to have OHSE strategies to satisfy both the Libyan National Oil Corporation (NOC) and their own operating and regulatory requirements. This again shows that HSE Protection Systems are increasingly becoming a principal component of such strategies. HSE guidelines are claimed to be in use both by individual companies and by Libyan national and international bodies operating in Libya.

There is wide recognition of the benefits of objective or goal-setting approaches to HSE protection, a fundamental principle of the HSE approach which draws on the management principles of the International Standard on Quality Systems, such as ISO 9000 and ISO 14000, ISO 18000 and ISO/TS 29001. Bearing in mind the important differences in the detailed handling of HSE protection issues, it is indeed tending to converge towards the systems model of ISO 9000. Many international players operating in Libya who are Exploration and Production (E and P) Forum Members do claim to operate joint Health, Safety and Environment Management Systems. American Petroleum Institute (API) has issued recommended practices, such as RP 75 that recommends good practice of Safety and Environmental Management Program for Offshore Operations, to assist those developing HSE Management Programs in the offshore oil and gas industry. Reference Recommended Practice for Development of a Safety and Environmental Management Program for Offshore Operations and Facilities Upstream Segment API (Recommended Practice 75 Third Edition, May 2008).

The requirements of HSE protection are not always in harmony. For example, measures necessary to safeguard personnel in emergencies may have adverse environmental effects, and vice versa. However, joint consideration of HSE matters need to be resolved, so that an appropriate balance is struck. This would help provide a framework within which such issues are tackled.

This thesis aims to develop and apply an effective HSE performance review for the Libyan oil and gas sector with a view to:

1. Cover relevant HSE issues in a single document.
2. Be relevant to the major activities of the exploration, production and processing of oil and gas industry in Libya.
3. Be sufficiently generic to be adaptable to different companies and their cultures operating in Libya.
4. Recognize, and be applicable to, the contractors and sub-contractors in the country.
5. Facilitate operation within the framework of Libyan National Oil Corporation (NOC) statutory requirements.
6. Facilitate evaluation of operations to Libya national and international standard(s) as appropriate.

The sought Libyan system aims at describing the main elements necessary to develop, implement and maintain an HSE management. The system is tested in case study companies or contracting companies seeking to help assure themselves and others (such as regulators, neighbours, partners, clients, insurers) of compliance with stated HSE policies within an objective-setting management system. These are aimed at supporting, rather than replacing existing company systems and practices.

The proposed HSE performance review model in this thesis involves developing a sequence of the elements, during many of the stages in practice. The model is intended to be a part of the overall management system of the facility or company. Current HSE guidelines for Libya are in line with the global system developed by the Oil and Gas Group (OGP). It has two main sections; ‘Guidelines’ and ‘Supplementary’. The suggested Libyan guidelines are developed after learning lessons based on experiences of OGP Guidelines. These guidelines describe the elements of the HSE model and their inter-relationships.

The above overview shows that different HSE protection management systems and strategies being applied by different companies and organisations in Libya using a variety of terms and definitions. The terms, which are used in this thesis, are defined in Appendix A. This includes terms such as ‘risk’, ‘hazard’, ‘performance criteria’, ‘audit’ and ‘review’. These are aimed at assisting an operating organisation responsible for HSE management and performance. The key elements of HSE are shown in Table 1.1.

HSE Element	Addressing
Leadership and commitment	Top-down commitment and company culture, essential to the success of the system.
Policy and strategic objectives	Corporate intentions, principles of action and aspirations with respect to HSE and its Management.
Companies, resources and documentation.	Companies of people, resources and documentation for sound HSE performance.
Evaluation and risk.	Identification and evaluation of HSE risks, for activities, products and services, and development of risk reduction measures management.
Planning and emergency.	Planning the conduct of work activities, including planning for changes and emergency response.
Implementation and monitoring.	Performance and monitoring How corrective actions are to be taken when necessary.
Auditing and reviewing.	Periodic assessments of system performance and effectiveness.

Source: OGP model (Oil and Gas Producer Association 2007)

Table 1.1: HSE Elements

1.3 An appraisal of HSE challenges in Libya

Incidents covering HSE mishaps in any or all of Libyan oil and gas sector operations pose a threat to human and material losses that are very costly and have significant impacts on both the industry and the economy. These challenges are becoming as part of overall corporate social responsibility in the country making a shift from traditional focus on worker's health and safety within the geographical boundaries of a national project to community health outreach programmes and assessment. This practice of assessment in the oil and gas sector in Libya using remote sensing and GIS technologies is relatively new for both new and existing oil and gas projects in Libya. In addition, health and safety specific assessment standards of practice and technical methodologies in the country are less well defined and established.

There is a lack of understanding due to prevailing difference between policy level and project level assessment by NOC of Libya government and multilateral lending agencies like World Bank. The challenge of this research is to develop a Libyan oil and gas sector specific guidance framework document with a common understanding of basic concerns, principles and practices for oil and gas industry that would be relevant across a diversity of its projects with both new proposed activities and existing operations.

Despite active support in HSE by the National Oil Corporation (NOC), oil companies still face major problems in tackling major professional accidents to which employees are exposed. They face the difficulty of measuring and controlling health and safety performance.

Despite the huge importance of oil industries, there is a lack of sufficient directional guidelines on how to measure HSE performance management in the oil and gas sectors of the country. There currently exists no one uniform standard method for evaluating and reviewing the various operators in the country as required by Libyan legislation. The current method based on a comparison of accidents statistics alone is inadequate.

The need for review and measurement of HSE performance management has been henceforth tackled by early research studies, and confirms the need to change from a reactive to a proactive approach. There is an urgent need for introducing measurements to forecast potential incidents, accidents or activities before they occur as explained above. This requires nationalisation of these technologies through building a team of qualified nationals, capable of carrying out such tasks, supporting decision in all aspects of upstream, midstream and downstream oil and gas industry. This would require the creation of a new platform for facilitating HSE data visibility for sharing and communication.

Tarrants (1980) indicated that such measure should describe and specify when and where the employee would expect the problem would take place, in addition to providing guidelines related to treatment actions. We should focus on review and measurement of HSE security behaviour instead of reporting insecure behaviour. Insecure behaviour results in accidents whereas healthy behaviour would prevent the occurrence of accidents in the first place.

The major factor in controlling and improving any performance activity is the ability to measure such activity. (Tarrants and Laufer, 1986) contend that accidents prevention and measurement of HSE protection performance management are necessary due to the following reasons:

- To be the foundations for revealing the accident initiating cause.
- To describe the safety condition prevalent in the company.
- To be the basis for taking resolutions for allotting resources for accidents prevention.
- To evaluate material accidents costs.
- To specify and define hazardous zones.
- To be the basis for evaluating the efficiency extent of accident prevention programs.
- To be the basis for comparing, direction/ disputes.
- To be the basis for forecasting future accidents problems.
- To create and specify long-term control over accidents.

In the last decade of the 20th century and beginning of first decade of 21st century, the UK witnessed the most significant changes in HSE regulations, more than at any other time before the first introduction of the safety legislations in the middle of the 20th century (Ahmad, 2000). The new regulations, especially the 1992 regulation relative to safety and health at work, have indicated the general structure, and framework of the safety management contained in the 1974 act relative to health and safety at work (Booth and Lee, 1995).

The standard of HSE protection performance management within the organisation includes accidents cases (Secure behaviour / insecure circumstances), which would have high accident occurrence potential in production but not necessary causing losses (just injuries and damages of property) whenever they occurred. Consequently, measuring efficiency of HSE protection, would allow us to become capable of specifying accidents problems which would have high potential of causing future losses, in addition to those which now lead to causing property damage, injuries, deaths or permanent impairments. Such measurements must detect when a problem would be likely to happen and should provide the person with some ideas on what should be done to control it.

Proper management of HSE condition should contain all accidents and incidents. Therefore, sound measurement of the HSE case should include all accidents and incidents.

The sought HSE performance review methodology would provide an opportunity to assess the efficiency of HSE.

The research questions emanating from the aforementioned challenges include the following:

- Is the HSE performance review methodology appropriate for all or certain circumstances?
- How is the measurement of HSE protection performance management undertaken in oil and gas sector companies in Libya?
- What outcomes should the performance review methodology yield?

To answer the above questions, it is necessary to obtain data directly from oil and gas industries in Libya, especially from HSE protection experts, the civil defence supervisors and industrial security officials.

1.4 Research aim and objectives

The research aim and objectives are given below.

1.4.1 Aim of research

The aim of this research is to design, develop and validate a structured HSE performance review methodology for the oil and gas industry in Libya.

1.4.2 Objectives of research

Taking into consideration the above-stated aim and purposes, the previous study in Health Safety and Environment management and the existing relationship between oil and gas industry and officials, the thesis has the following objectives:

1. To carry out an extensive literature review on best practice HSE Protection Performance Management.
2. To carry out a critique on HSE Protection Performance Management in the Libyan oil and gas industry (NOC Data Analysis).
3. To carry out a pilot study to gain a first impression of the level of awareness and commitment to Health Safety and Environment (HSE) Management in the Libyan oil Industry - Stage 1 of empirical research validation process (Pilot Study Questionnaire).
4. To carry out empirical research assessing the nature and conditions of successful HSE Performance Management in the context of the oil and gas industry – Stage 2 of empirical research (Interviews).
5. To identify critical HSE protection performance indicators in the Libyan oil and gas industry – Stage 3 of Empirical Research (Questionnaire).
6. To develop a practical HSE performance review methodology based on the literature review and empirical research results.
7. To validate the HSE performance review methodology by direct application to a number of selected companies and revise the methodology where appropriate.
8. To propose an associated implementation plan in Libya.

The research outcomes are:

- A practical framework for HSE performance review in the Libyan oil and gas Industry, with a concise aide-memoire in the form of guidelines for "how to do it best".
- An implementation plan based on a 3-year review with direct dissemination of results to the public, and issuing of penalties for poor performance.

1.5 Research methodology

The research methodology has been selected taking into consideration a multiple purpose method (empirical study, personal interviews, questionnaires and case study) to develop and validate the performance review method. The research methodology is shown diagrammatically in Figure 1.2.

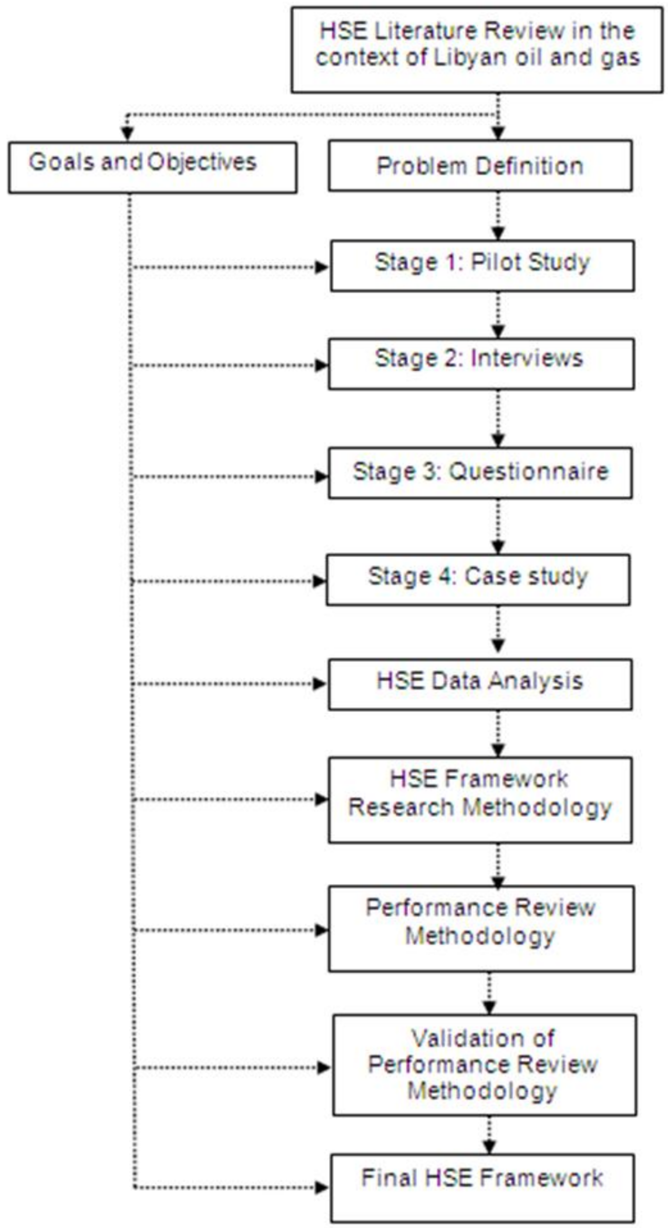


Figure 1.2: HSE Study Architecture

This study represents an interpretative study aiming at consolidating prevalent theories and provides a comprehensive performance review of HSE. Consequently, reviews and measurements of: "What", "How" and "Why" approach are fundamental to understanding the application of HSE protection process. "What" features in the study require the use of quantity whereas "How" and "Why" require the use of way methods (methodology, criteria and objectives).

In this research, a triangulation method is used to confirm the results and consists of questionnaire, interview and case study methods. Based on the indicators of HSE protection management obtained from the empirical questionnaire, a structural interview questionnaire has been used, complemented with personal interviews targeted with targeted HSE professionals in Libya.

After gathering data and conducting analysis, based on extensive discussion, explanation and interpretation of results, a structural HSE performance review method related is presented. The method is validated by direct application to a number of oil and gas companies.

1.6 Research scope

This research is designed to study HSE and related management issues for oil and gas industry in Libya. It includes all aspects of health safety and environment elements such as:

a) Advising on safety and industrial hygiene regulatory requirements and best practices.
b) Developing safety procedures and guidelines.
c) Conducting HSE inspections and audits.
d) Conducting exposure assessments and monitoring.
e) Evaluating and addressing economic risks.
f) Advising on strategies to improve HSE performance.
g) Working to ensure compliance. In addition it also includes environmental protection related issues such as:
    1) Advising on international and Libyan environmental regulatory requirements and best practices.
    2) Working with regulatory agencies like LNCSM, Libyan National Oil Corporation (NOC) and EGA to obtain permits.
    3) Developing environmental procedures and guidelines.

4) Conducting emissions modelling for air, waste or water.
5) Performing studies to estimate and reduce emissions.
6) Implementing waste management programs.
7) Assessing and managing environmental, social and health impacts.
8) Assessing control technologies.
9) Handling contaminated sites.

HSE management issues related to Libyan oil and gas industry are also examined with a view to developing and implementing a HSE performance review methodology in respect of both international and domestic oil and gas businesses operating in Libya. These include upstream, midstream and downstream exploration and production activities. Reference has been made to similar studies related to oil and gas industry around the world in general, although other sectors and/or some aspect of HSE are also considered which offer useful information.

The scope of this research is to develop and apply an effective HSE framework to the Libyan oil and gas sector that covers all relevant issues in a single document. The developed framework is relevant to the activities of the Exploration and production and processing of oil and gas industry in Libya. It is sufficiently generic to be adaptable to different companies and their cultures operating in the country. The ultimate aim of the research is get the HSE performance review methodology formally recognised in Libya so that it becomes applicable to all national and international oil and gas companies operating in Libya and within the framework of Libyan National Oil Corporation (NOC) as statutory requirements.

1.7 Contributions to knowledge

The main contributions from this work can be summarised as follows:

1. A detailed description of global, regional, national and local HSE framework that can be used as a reference of knowledge to help change organisational culture from traditional HSE protection compliance to operational risk management.

2. A newly developed HSE performance review methodology validated by direct application to a number of case studies.
3. A development of practical quantitative designed to improve HSE performance at both national and international levels.
4. A forward looking framework which will help domestic and international oil and gas companies in Libya to move to a more modern way of assessing HSE, which is commensurate with other disciplines.
5. A transparent HSE methodology where good practices and opportunities for improvement are made public and help improve benchmarking.

1.8 Structure of Thesis

Chapter One presents an overview of entire thesis and highlights various aims and objectives of the research project along with challenges about HSE performance assessment and the urgent need for an improved and validated framework related to both domestic and international oil and gas companies operating in Libya.

Chapter Two reviews the available literature in the context of oil and gas industry, and which relate more specifically to the issues of performance measurement. After highlighting the role of management and organisation factors in HSE matters, the chapter reviews main HSE management standards and systems and regulations. Finally, the chapter reviews HSE management auditing procedures along with common HSE auditing tools and the benefits of an integrated approach. An in-depth summary of occupational HSE protection aspects and sub-aspects that are generally given in early studies related to drilling fluids and their risk management, OHSE and Health Impact Assessment (HIA) are also provided in this chapter.

Chapter Three presents and reviews definitions of HSE problems in Libyan oil and gas industry along with a detailed critique. It introduces an overview of the essential role of oil and gas industry in the Libyan economy based on HSE protection issues in companies representing the Libyan oil and gas sector. The chapter discusses up-stream, mid-stream and down-stream oil and gas industrial aspects related to impact assessment for effective HSE operations and activities. It also highlights the role of the Libyan National Oil Corporation (NOC).

Chapter Four explains the research methodology adopted. It includes explanations and reasons for selecting methods for data collection and analysis. It also presents strategies evolved to handle quantitative and qualitative analysis of the questionnaire responses. Rationale for choosing triangulation design is the main highlight of the chapter.

Chapter Five presents the design and development of a structured HSE performance review methodology in the Libyan oil and gas sector. It presents six HSE aspects developed as a result of the output of a series of discussions with experts, and structured interviews at oil industries in Libya, together with a list of HSE performance indicators that have been identified from the literature review to help form the basis of the review methodology.

Chapter Six describes the validation of the HSE performance review methodology developed. This is achieved based on actual performance review visits to selected oil and gas companies in Libya.

Chapter Seven describes a proposed implementation plan of the HSE performance review methodology in Libya.

Chapter Eight presents conclusions and recommendations of the research.

Chapter 2: LITERATURE REVIEW ON HSE MANAGEMENT IN THE OIL AND GAS INDUSTRY

This chapter presents a literature review on Health Safety and Environment (HSE) in the context of oil and gas industries. The following guidelines and standards are reviewed and critically compared:

- Oil and Gas Producer (OGP) guidelines (2007).
- Risk Management Programme (2014).
- Management of Process Hazards. American Journal of Engineering and Applied Sciences (2012).
- Chemical Manufacturers Association Systems CCPS (Center for Chemical Process Safety) - Technology and Engineering (2010).
- Process Safety Management. International Oil and Gas Producer (IOGP) guidelines (2016).
- Odour Impact Minimization Plan (OIMP) guidance to on-site personnel in the handling, storage, and removal of compostable materials, in accordance with title 14, California Code of Regulations Section 17863.4 (2015).
- Health and Safety at Work 1974 (HASAWA).
- Health and Safety Guidance HSG 65 Second edition, (1997).
- BS 8800:2004 Occupational Health and Safety Management System (2004).
- OHSAS 18001 Occupational Health and Safety Assessment System (2015).
- ISO 9000 Quality Management (2015).

This chapter aims to review the literature in respect of HSE in the context of the oil and gas industry and identify the challenges that organisations face when implementing such guidelines and standards. It includes the following list of key components:

1. HSE leadership and commitment.
2. Employee participation.
3. Process safety Information.

4. Risk analysis and management.
5. Reliability of critical systems and devices.
6. Facilities design and construction.
7. Operation and maintenance procedure.
8. Occupational health and hygiene.
9. Environment management.
10. Personal safety.
11. Training.
12. Contractors and business associates.
13. Work permit system.
14. Management of change.
15. Emergency planning and response.
16. Incident investigation and analysis.
17. Safety audits.

The issues of HSE performance measurement in the multinational and domestic companies in Libya highlight the important role of management and organisational factors. This chapter discusses the drivers for improved HSE performance. It highlights the main HSE management standards and associated regulations and reviews HSE management auditing procedures together with common HSE auditing tools. An in-depth summary of occupational HSE protection aspects and sub-aspects that are generally given in early studies related to drilling fluids and their risk management, Quality Health Safety and Environment (QHSE) and Health Impact Assessment (HIA) are also discussed in this chapter.

2.1 An overview of HSE in the oil and gas industry

In the early stage of industrialisation, HSE was managed through training, safe procedures, and compliance with rules and regulations. The next phase witnessed an enhanced safety feature through technological advances - safe processes, and safety features built in design and prescriptive statutory rules. Today, HSE is managed through a systems approach. (Cullen, 1991) on Piper Alpha Disaster stressed the need for a formal safety management system and showed that HSE is widely recognised as an integrated approach of Management, Leadership Commitment and Coordinated Technical Interventions from concept to commissioning and commercial operations. There are now numerous HSE programs for Risk Management Programme worldwide. They include:

- Management of Process Hazards.
- Guidelines for Technical Management of Chemical Process Safety,
- Process Safety Management,
- Exxon OIMP (Operations Integrity Management Practices).
- OGP Drilling fluids and health risk Management guidelines for upstream E and P.

2.1.1 Environmental Management System (EMS) in Oil and Gas Industry

In so far as environmental management within the oil and gas sector, there is a template based on the International Organisation for Standardisation's. ISO 14001 requirements for an EMS are designed to allow an organisation formulate a policy and objectives based on legislative requirements and information about significant environmental impacts. The standard considers only those environmental aspects that the organisation can control and over which it can be expected to have an influence.

The ISO 14001 requirements are comprised of five main steps for ensuring that environmental issues are effectively addressed in project and company activities and operations and are:

- Environmental Policy.
- Planning.
- Implementation and Operations.
- Checking and Corrective Action.
- Management Review.

2.1.2 Energy and Biodiversity Initiative in Oil and Gas Industry

As described in the Energy and Biodiversity Initiative each of these stages, it is possible to integrate biodiversity considerations to more fully address the potential biodiversity impacts of oil and gas development. Although these five steps are often represented in a linear sequence, many of them are conducted simultaneously as shown in Figure 2.1.

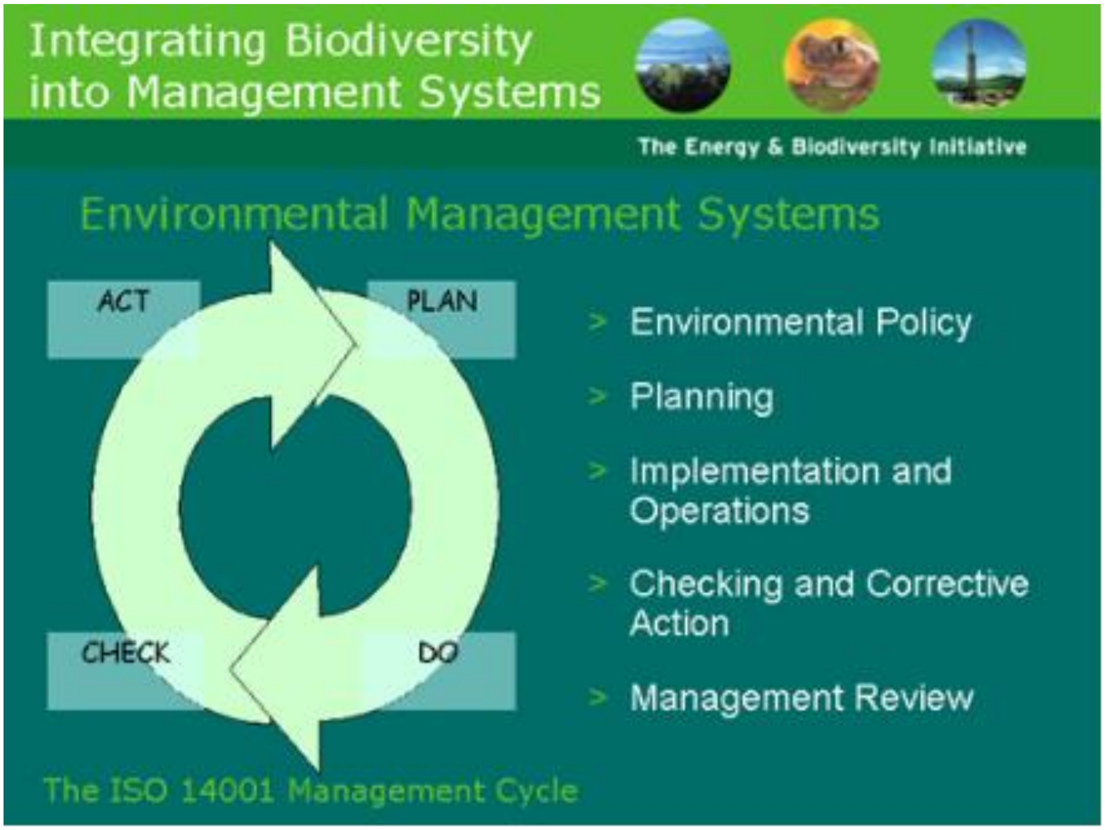


Figure 2.1: The Energy and Biodiversity Initiative: PDCA cycle

Other templates for environmental management within the oil and gas sector are based on the Guidelines for the Development and Application of Health, Safety and Environmental Management Systems, published by the Exploration and production Forum, now named the International Oil and Gas Producers Association (OGP, 2007). This should be in the Ref OGP Guidelines that have been developed to integrate relevant HSE concerns in a single approach, while remaining sufficiently generic to be readily adapted by different companies and their organisational cultures. The Guidelines describe the main elements necessary to develop, implement and maintain an HSEMS, but do not prescribe specific performance requirements. Instead, they recommend that companies set policies and objectives that consider significant hazards and environmental effects of their operations.

The OGP guidelines include seven main steps for addressing environmental issues in project and company activities and operations as shown in Figure 2.2.

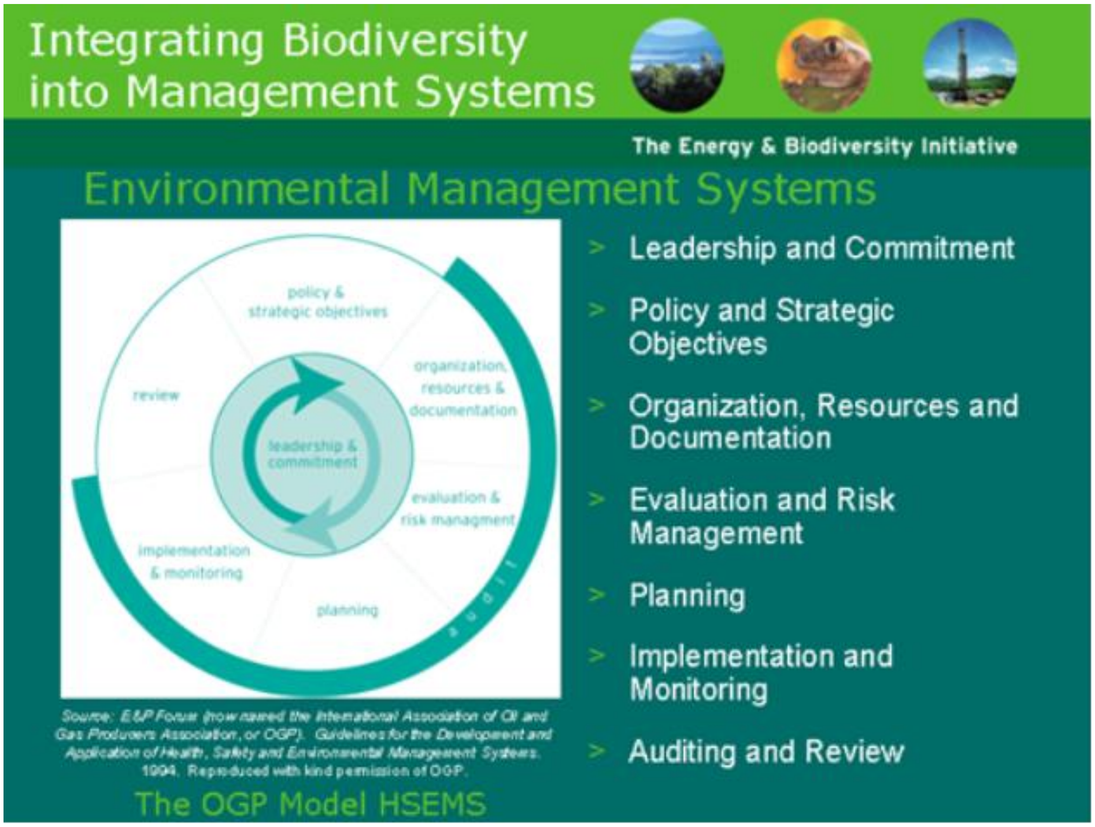


Figure 2.2: The Energy and Biodiversity Initiative: 7 steps

At each of these stages, it is possible to integrate biodiversity considerations to more explicitly address the potential biodiversity impacts of oil and gas development. Many of these steps will be addressed simultaneously, or revisited at different times, rather than in a linear sequence.

The integration of environmental and social impact assessment for the oil and gas sector in Libya is treated as one process and is part of the EGA led legislative framework for environmental policy. Libya discharges its responsibility by following the Conference of the Parties (COP) which impacts should be evaluated at the genetic, species, community; and ecosystem and habitat levels, encompassing the appropriate temporal and spatial scales, values for affected people, and the type of mitigation required.

2.1.3 Environmental and social impact assessment (ESIA) in oil and gas industry

The oil and gas companies in Libya need to develop ESIA Craig (2015) that helps address the existing set of EGA and NOC standards and requirements relating to biodiversity or the protection of biological resources. The process begins at the project planning stage, to avoid unforeseen negative impacts and to identify and implement necessary mitigation. It is required to ensure that an ESIA process is fair and credible. It is achieved through full and public stakeholder engagement, with all affected and interested parties, particularly at the scoping and review of following steps.

1. Identification of alternatives.
2. Screening.
3. Scoping.
4. Baseline establishment.
5. Evaluation (impact analysis).
6. Development of mitigation options and implementation.

The above primary impacts, also sometimes called direct impacts, result specifically from project activities. These impacts are most familiar to project managers and need to be included in a standard ESIA. Primary impacts are normally limited to the geographical area of influence of the project and can often be alleviated when projects incorporate sound operational management, impact mitigation and biodiversity conservation practices from the earliest stages of design.

Secondary impacts are usually triggered by the operations and may result in the following:

1) Reach outside project or even concession boundaries.
2) Endure or begin after a project’s life cycle.
3) Be predicted by ESIA.
4) Be identified or realised until much later in the project cycle, or after decommissioning.

Secondary impacts usually do not result directly from project activities but instead are triggered by the project presence. These impacts may reach outside project or even concession boundaries and endure or begin far beyond a project life cycle. A broad-based ESIA that explicitly includes biodiversity considerations is the primary tool to predict potential impacts to biodiversity and determine ways to mitigate those impacts.

Secondary impacts are often the result of government decisions or indecision and the actions and practices of nearby communities in response to a project presence, rather than from the operational decisions and activities of project personnel. Thus, it may be difficult to identify who is responsible for addressing such impacts.

Furthermore, while primary impacts can often be mitigated and even eliminated with familiar technologies or management practices, secondary impacts tend to arise from complex interrelationships among social, economic and environmental factors in a local area. In some cases, they will result from company activities that contribute positively to economic development, such as road-building or local employment. Their solutions are thus more difficult to identify and implement, and a company may be unable to fully address and prevent such impacts on its own. Nevertheless, failure to manage such impacts can have huge negative consequences for a company’s project success and overall company reputation.

Secondary impacts are most commonly caused by human population changes in an area and new or additional economic activities resulting from project infrastructure such as roads, ports and towns. These impacts are particularly pronounced in previously undeveloped and remote areas. Oil and gas operations are often magnets for people hoping to find employment with the project or to take advantage of additional business opportunities created by the project need for goods and services. In some cases, this emigration is encouraged by local or national governments, thus making secondary impacts a particularly sensitive political issue.

As local population increases, demand for housing, food and other goods will grow, putting additional pressure on natural resources such as timber, land, water and wildlife. An oil and gas operation may also provide access to an undeveloped area for people who are interested in using previously inaccessible land or resources for purposes unrelated to the project. For example, building or upgrading roads or pipelines into areas that have previously been inaccessible for development can facilitate settlement, agricultural colonisation, and other pressures on natural resources.

Just as negative secondary impacts are usually caused by a wide range of stakeholders, their solutions will also require cooperation among many parties. Early and active engagement with all relevant stakeholders, from local communities, to government officials, to national and international conservation organisations, can help to identify potential environmental and social conflicts, build trust, identify boundaries of responsibility and promote cooperation among all parties in addressing and preventing secondary impacts. Sometimes there will be conflicts between conservation and development goals that make resolving the issue of secondary impacts even more complicated and beyond a company's sole ability to manage – for example if a local community is in favour of a road that the conservation community opposes.

One of the most important ways that companies can contribute to resolving such conflicts and addressing the challenge of secondary impacts is by encouraging and participating very early on in regional planning exercises in the areas where they work or plan to work, (Reason, 1998). These exercises should be led by governments but involve all key stakeholders. Based on the interests of the authorities, the general public and the private sector, regional plans can help establish priorities and conditions for economic activities, community development and biodiversity conservation. Proceeding with project development in the context of a general plan for conservation and sustainable development on a regional scale will help a company ensure that its field operations are managed in a strategic way, to promote sustainable development and conservation and to avoid the potential for unforeseen issues that might lead to extensive secondary impacts.

An energy company trying to decide whether to exploring for and developing hydrocarbon resources in an area that may also have high biodiversity values needs a decision-support framework that can allow it to identify and prioritize the risks and benefits of working in a certain area and guide choices about whether to pursue specific business opportunities.

This framework should be relevant and useful in the very earliest stages of business development, before a concession is acquired and when a company's interest in an area may still be subject to confidentiality constraints. While governments ultimately make decisions about development in areas under their control, energy companies must determine whether the inherent risks of operating in certain areas – both with respect to biodiversity and in terms of the company's project risk and /or reputation – are unacceptably high.

A full integration of environmental and social issues that encompasses biodiversity concerns need to look beyond the oil and gas project's boundaries and lifetime, to include the wider, cumulative impacts of a project over a broader ecosystem area. It is important to examine these effects over the long term, as seemingly small or gradual changes may have a very significant cumulative impact. Often, the holders of traditional knowledge of an area may have important insight into the potential for such changes.

Most of the oil and gas industry experience special risks associated with oil exploration, production in upstream, transportation in midstream and following risks in downstream specially during refining since crude oil is a highly flammable material, which has the following characteristics:

1) High temperature and pressure.
2) Modern technologies use hydrogen extensively.
3) Corrosive and reactive.
4) Self-ignition on leakage from system.
5) Uncontrolled process reactions.

2.2 Elements of HSE management systems

Based on the review of literature in respect of most global, regional and national oil and gas companies operating in Libya, HSE management systems include the following elements:

1. HSE Leadership and Commitment.
2. Employee Participation.
3. Process safety Information.
4. Risk Analysis and Management.

5. Reliability of Critical System and Devices.
6. Facilities Design and Construction.
7. Operation and Maintenance Procedure.
8. Occupational Health and Hygiene.
9. Environment Management.
10. Personal safety and Training.
11. Work Permit System and Safety Audits.
12. Management of Change.
13. Emergency Planning and Response.
14. Incident Investigation and Analysis.

2.2.1 HSE leadership and commitment

This pertains to the following:

1) Corporate HSE policy approved by Board of Directors.
2) Periodical updating made available to all the employees, business associates.
3) Establishment of HSE Management Systems at all locations.
4) Monitoring of HSE Performance.
5) Formation of HSE Committees.
6) Management HSE Committee.

2.2.1.1 Promotion of HSE culture

It involves the following**:**

1) Safety Award Scheme.
2) Allocation of resources to improve safety, health and environment performance.
3) Personal Protective Equipment (PPE) - Punishment for noncompliance.
4) Surprise checks.
5) Safety promotional activities including display of poster, and safety talk to contractor workmen.
6) Assessment of HSE awareness Level.

2.2.1.2 HSE manual

The HSE manual should include procedures and work practices related to:

1) Safety.
2) Fire.
3) Occupational Health.
4) Environmental Management.

2.2.2 Employee involvement

Employee involvement is discussed in the sections below:

2.2.2.1 Employee participation

Employees should be involved in all elements of HSE Management System and must include:

- Plant Manager - Overall responsibility.
- Training Coordinators - assess training need, ensure skills and refresher training.
- Supervisors - encourage for reporting of potential hazards.
- Scope of Employee participation includes the following:
- Compliance of HSE rules and regulations.
- Follow safe operating practice.
- Involvement in development and updating of operation/maintenance procedure.
- Inclusion in pre-start up HSE reviews team.
- Involvement in development of training material.
- Imparting training to fellow workers.
- Use of Personal Protective Equipment (PPE).
- Involvement in incident investigation.
- Involvement in HSE audit.

2.2.2.2 Personal safety

- It provides appropriate type of (PPE) for protection of:
- Head, Eye and Face.
- Respiratory system.
- Hearing.

- Hand, Foot.
- Enforce and ensure correct use.
- Provide fall protection while working at height.

2.2.2.3 Contractors and business associates

This involves:

- Constitute large proportion of work-force
- Evaluation of HSE Performance of Contractors
- Trained for safe operation
- Personal Protective Equipment (PPE)
- Information about potential fire, explosion and toxic release hazards
- Contractors are responsible for organising their work and maintain tools

For project construction jobs, contractors have to employ full time HSE officer, who has responsibility as the following.

- Frequent safety talk to contractor labours to raise their safety awareness.
- Help the contractors to ensure that their employees follow safety rules of the corporation.
- Regular safety meeting with the contractors.
- Ensure that the contractors comply standard safety Practices during Construction.
- Carry out construction HSE audit.

2.2.2.4 Work permit system

This is required to ensure that there are duly authorised written permit and has the following characteristics:

- It is a pre-requisite for carrying out any job in hazardous premises other than by the operating personnel.
- The system operates on ‘Owner-In charge’ concept. Management issue appropriate authority limits - Gas Safety Inspector and Fire Permit Signatory.
- Permits are printed, serially numbered and colour coded.

- Before issuing a permit, proper isolation of equipment, oxygen deficiency tests to be ensured.
- For the jobs to be carried out by the contractors, permits are issued by company supervisors.
- For critical jobs like drill cutting, approvals from higher level officers are required.
- Ensure that after completion of the job, area is cleaned and the permit is returned to the issuer who also signs and keeps record for one month.

2.2.2.5 Management of change

This involves:

- Ensure evaluation of potential impact, authorising and control for changes in process technology, equipment, instrumentation and procedures.
- Proposed changes to be reviewed by related functions/departments.
- Operating and maintenance personnel are to be trained on changes.
- Same control to be exercised for temporary as well as permanent changes.

2.2.3 Process safety information

This includes complete and accurate information about:

- Physical properties like vapour pressure, boiling point etc.
- Fire and explosion hazards like flash point, auto ignition, temperature, etc.
- Reactive hazards (tendency to react violently).
- Health hazard (toxicity).
- Corrosive properties.

2.2.3.1 Process technology

This involves:

- Written down process description.
- Process chemistry.
- Safe Operating limits.

2.2.3.2 Process equipment

This involves:

- Tools of maintenance.
- Materials of construction.
- Design Specifications.
- Electrical classification.

2.2.4 Risk analysis and management

This includes:

- Hazard identification.
- Cause-consequence analysis.
- Hazard and Operability Studies (HAZOP).
- Quantitative Risk Analysis.
- HSE Audit Studies.
- Individual and Societal Risk Assessment.
- Risk Contour Mapping.

Appropriate review of risk once in three years for existing plants based on:

- Internal/external safety audits.
- Previous risk assessment.
- Accident Investigation Reports.
- Risk Analysis and assessment of new projects.

Currently most companies use the system based on the country of their origin e.g. Shell uses the Netherlands' guidelines and British Petroleum (BP) uses the UK's criteria.

2.2.4.1 Reliability of critical systems and devices

This involves:

1. Safety critical systems and devices to be identified and approved by management to:

- Prevent serious process accident.
- Mitigate the results of loss of containment.

2. Identification should be based on:
    - Environmental critical systems and devices.
    - Prevention of release of material that would cause serious environmental impact.
    - Mitigation of environmental impact.

2.2.4.2 Testing and maintenance requirements

This involves:

- Identification of systems/devices, which are periodically tested and undergo maintenance.
- Procedure for testing and maintenance exists.
- Testing/maintenance are properly documented and analysed.
- Temporary deactivation/bypassing facility exists.
- Approval procedure for bypass/deactivation exists.

2.2.4.3 Facilities design and construction

This involves:

- Initial hazard review for the new projects.
- Clear plant layout.
- Operating and design condition.
- Basic specifications.
- Control philosophy and redundancy.
- Quantity of the material in process and storage requirement.
- HSE review by a specialised group during detailed design stage.
- Some of the important items for consideration are as below:
- Automatic valves at key locations in the plant and utility system.
- Automatic deluge sprinkler system on Liquid Petroleum Gas (LPG) storage.
- Water spray on vertical tanks.
- Arrangement of fire fighting for tall structures.

- Fire protection system and arrangement for draining water used in fire fighting.
- Water draining facility from LPG storage and location of ROV (remotely operated vehicle) shall be first from the vessel.
- Safe access and exit from plant/equipment.
- Electrical installations based on area classification.
- Gas detection system.

2.2.4.4 Operation and maintenance procedure

Comprehensive operating, inspection and maintenance manuals need to be prepared and made available to the concerned personnel. It must be reviewed and kept updated once in a year.

Operating manuals should contain:

- Equipment operation, normal starts up and shut downs, emergency handling procedures.
- Limits of operating parameters and consequence of crossing the limit.
- Interlocks and safe shut-down instrument functions and its special features.
- Contains work permit system, equipment hand-over, fire protection facilities etc.

Total Preventive Maintenance (TPM) it is a method designed to eliminate the losses caused by breakdowns of machines and equipment through identifying and attacking all causes of breakdowns and system down time. TPM must include:

- Regular Preventive Maintenance including housekeeping.
- Periodic pre-failure replacement or overhauls.
- Intolerance for breakdowns or unsafe conditions.

TPM places a high value of teamwork and continuous improvement. Thus the maintenance procedures need to include:

- Procedure for carrying out TPM and preventive maintenance.
- Procedure for carrying out predictive maintenance.
- Shut-down/emergency maintenance.

- Job description.
- Interface with other functions.
- Details of special maintenance procedures.
- Testing procedures.
- Materials specifications.
- Methods of documentation.

2.2.5 Occupational health and hygiene

The objectives are:

- Promote health care of the person behind the machine.
- Early detection of occupational disease.
- Identify, evaluate and control of hazard at work environment.
- Occupational health monitoring.
- Major requirements include:
- Pre-employment medical examination.
- Periodical medical examination - target organs.
- Well person screening of employees above 40 years.
- Sound level monitoring in high noise areas - once in 6 months.
- Checking and surveillance of First Aid boxes.
- Provision of safe drinking water.
- Proper disposal of Bio-medical waste.
- Auditing - once in 2 years.

2.2.6 Incident investigation and analysis

This is designed to:

- Ascertain cause, recommend remedial measures to prevent recurrence and document lessons learnt.
- Investigate by multi-disciplinary team.
- Implement recommendations.
- Study near-miss situations.
- Undertake case studies for in-house training programmes.

2.2.7 Environment management

Compliance of statutory requirements including:

- Identify sources of water pollution.
- Reduce generation of waste-water and recycle.
- Identify sources of at Compliance of NOC/EC environment conditions.
- Documented oil and gas spill response.
- Development of green belts/tree plantation.
- Training and awareness to all employees, and local community.

2.2.8 Continual improvement in atmospheric pollution

Reduce generation of waste needs to be carried out for:

- Adopting cleaner technology.
- Safe disposal of hazardous wastes.
- Waste water treatment.
- Ambient air quality monitoring.

2.2.9 Emergency planning and response

This involves:

- Dedicated Fire fighting facilities.
- Fire tenders/Nurses/Hydrant system.
- Water Storage/Pumps/Alarms etc.
- Detectors for Early Warning.
- Well-trained fire crew round the clock.

2.3 Health impact assessment in oil and gas industry

Health Impact Assessment in the oil and gas industry is treated as a process comprised of compound state of complete physical, mental and social well-being. It is designed to determine the lasting or significant changes, positive or negative, intended or not, in community's lives and the natural environment brought about by a given action or series of actions related to oil and gas exploration and production. As per WHO, HIA as 'a combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population'. Broadly, two basic types of HIA are called as Comprehensive HIA and Rapid Appraisal HIA.

- **Comprehensive HIA:** It consists of a detailed process that includes the basic elements of screening, scoping, stakeholder consultation, risk assessment, implementation and monitoring, quality assurance and verification. It is a time-intensive study that is suitable for large complex and high profile projects.
- **Rapid Appraisal HIA:** These are 'mini HIA' and 'desktop HIA forming a qualitative assessment'. A mini HIA uses information already available or easily accessible. A desktop HIA is internal to the organisation and used to inform and comment on the proposal direction.

A comprehensive HIA is a participative and interactive process with a broad range of stakeholders at every level. HIA when used at any stage of the industry life cycle in oil and gas industry can help in exploration and development, modification of an existing activity or closure of previous projects. HIA seeks to identify and estimate the lasting or significant changes (positive or negative, single or cumulative) of different actions in oil and gas industry on the health of a defined population. The potential for uneven differences is generally referred to as the 'assessment of equity'. The overall mitigation strategy can help in developing into an implementation plan that includes a long-term monitoring (surveillance) programme with provision for frequent evaluation and review.

2.3.1 Health impact assessments in the oil and gas industry

Within the oil and gas industry in Libya, the majority of projects do not require a comprehensive HIA. Rapid appraisal HIA is suitable for many projects that involve minor or modest upgrades to existing production facilities. Generally large oil field developments, pipelines, liquid natural gas (LNG) facilities, chemical plants and refineries are appropriate projects for a more comprehensive HIA.

HIA has an extremely wide scope and use two basic models i.e. biomedical and social or socio-environmental. The biomedical model of health focuses on disease and illness and related causal mechanisms. The socio-environmental model tends to focus on the broader factors that contribute to health and well-being. Health determinants are the personal, social, cultural, economic and environmental factors that influence the health status of individuals or defined populations. This includes age, sex, genetic factors, air, water, housing conditions, income, employment and education. Policy level HIA utilize a broadly defined socio-environmental model using determinants of community health such as poverty and income. Project level HIA focuses on specific health outcomes. WHO socio-environmental approach considers six general health issues.

Table 2.1 gives the potential scope including both general disease categories and health determinants.

Health Issues	**Example**	**Knowledge base**
Communicable diseases	Vector-borne	Large, reliable
Non-communicable diseases	Pesticide exposure	Reliable, generalised.
Accidents and injuries	Construction and traffic-related	Reliable, some statistics
Malnutrition	Vitamin a deficiency	Variable, potentially quantifiable
Psychosocial disorder	Substance abuse	Poor reliability, cultural variation
Social well-being	Quality of life, equity	Variable reliability

Table 2.1: WHO Model of Health Issues

2.3.2 Oil and gas industry drilling fluids and health risk management

Drilling fluids are used extensively in the upstream oil and gas, and are critical to ensuring a safe and productive oil or gas well. During drilling, a large volume of drilling fluid is circulated in an open or semi enclosed system, at elevated temperatures, with agitation, providing a significant potential for chemical exposure and subsequent health effects. When deciding on the type of drilling fluid system to use, operator well planners need to conduct comprehensive risk assessments of drilling fluid systems, considering health aspects in addition to environmental and safety aspects, and strike an appropriate balance between their potentially conflicting requirements. The results of these risk assessments need to be made available to all employers whose workers may become exposed to the drilling fluid system. Drilling fluids are a key requirement in the vast majority of drilling operations. The main functions performed by drilling fluids are to:

- Provide a barrier for well control.
- Remove cuttings from the well bore as they are produced.
- Maintain drill cuttings in suspension when drilling circulation is stopped.
- Transmit hydraulic power to the drilling bit.
- Maintain formation stability.
- Maintain pressure on the formation.
- Control fluid loss through filtration.

Cool and lubricate the drill bit and string; and facilitate data logging-drilling fluids characteristics need to be controlled so that logging instruments can accurately provide information about the well and formations being drilled.

2.4 Occupational HSE system management activities

Occupational HSE management is an important activity to a company. Companies adopt different management practices depending upon their cultural background and various methods to control occupational health safety and environment risks.

2.4.1 Safety culture

The establishment of a safety culture "may be the most important work that can be undertaken by an organisation to improve plant safety" (Murely, 1990).

But, the first problem confronted is to find a definition of that. In this regard, several definitions have been suggested:

- "Gathering particulars and attitudes of organisations and individuals ensuring that safety issues are given the first priority over other issues" (Reason, 1998).
- "Safety culture is defined as a psychological status stressing safety" (Murley, 1990).
- "A set of beliefs, norms, attitudes, roles and practices" (Toft, 1994).
- "A product of the values, attitudes, perceptions, behaviour and behavioural models determining the adherence to the safety management of a given organisation and its technique and perfection" (Lee, 1994).
- A system built of meanings from which a given people understand the world risks".

Ludborzs (1995) states that good safety culture results from a safe behaviour becoming natural, clear-cut and undisputable for each person in an organisation and reduces risks confronted by peoples and laws disregard. He adds that it enhances morale and incentive of employee's promotion and development. Safety culture can be divided into five elements as below:

- Opportunities enhance development, independent action, and creative effort and reduce unintentional errors; hence it makes people feel they are important to the organisation in which they work. The best way to do that is to affect people and benefit from their own creativity. This enhances their feeling of responsibility. However, this should be associated with good management support.
- Stimulation keeps continuous improvement by maintaining high standards and establishing good examples. The management obligation should be clear and continuous to ensure that personnel understand the importance of excellence at work without taking short methods or decisive laws in addition to exerting doing utmost efforts safely and efficiently (Murely, 1990).
- Counselling advice instead of orders is the best way to instruct the details related to objectives, standards, performance and improvement of business. It enables personnel to enter information on the way of executing things to select the most efficient methods in this regard.

- Assistance Providing in the form of formation, training, instructions and rotation of work and time to participate in related development activities is required if all understand the importance of safe and efficient operation (Nieva, 2003).
- Recognising the role to be played by people in good safety practices requires positive evaluation while the problems identified during cultural evaluation should be referred to personnel who can undertake the required changes (Ruchlin, 2004).

2.4.2 Types of safety culture

Three cultural factors contributing to the development of strong safety culture have been identified as follows:

1. **Obligation:** A company seeks to be an industrial pioneer instead of being advanced by one step on regulators and where human and material recourses are allocated to rectify and remedy the organisation.
2. **Efficiency:** A company becomes technically efficient in fulfilling safety targets if it has suitable safety information system responding to safety-related information.
3. **Cognizance:** No amount of commitment or competence is any good without understanding the hazards endangering operations.

2.4.3 Personal protective equipment

Frontline professionals in the oil and gas industry face a vast number of life-threatening chemical hazards on a daily basis. Danger lurks in every activity, from building well foundations and erecting lease tanks, to chemically treating or hydraulically fracturing wells. In off-shore drilling, the dangers range from blow-outs, hydrogen sulphide gas during drilling, heavy metals and benzene present in crude, to asbestos, formaldehyde, hydrochloric acid and Normally Occurring Radioactive Materials (NORMs). Even in normally safe refineries, certain activities – process sampling, inspection, handling or recharging catalyst – pose chemical risks.

Risk is also higher during regularly scheduled maintenance and repair shutdowns. Workers are also potentially exposed to flames and fires and other consequences of explosions. Workers need strong protection against all of these potential risks, and to be able to comfortably work in their protective clothing for their entire shift. First aid equipment should be in the medical clinic at the work place, when performing tasks such as tripping wet pipe or in work environments that are heavily contaminated with oil mist.

The rule in oil and gas companies that no one is allowed on site without this gear, for their health and safety to prevent direct contact with oil, gas and chemical. When working with drilling fluids, if ventilation is not adequate it is recommended that goggles and self-contained respirators are worn at all times. Respiratory Protective Equipment (RPE) is considered to be a last resort. RPE should only be considered when exposure cannot be adequately reduced by other means. It is vital that the RPE selected is adequate and suitable for the purpose. It should reduce exposure to as low as reasonably practicable, and in any case to below any applicable occupational exposure limit or other control limit.

To make sure that the selected RPE provides adequate protection for individual wearers, fit testing of RPE including full-face masks, half-face masks and disposable masks is strongly recommended. This will help to ensure that inadequately fitting facemasks are not selected. Positive pressure is not a substitute for adequate fit; it only provides an additional margin of protection. Combination filters with organic vapour cartridges should be used when performing activities where there is the potential for hydrocarbon exposure.

Personnel involved in drilling operations may be exposed to hazardous components of drilling fluids. Therefore, the principles of risk management and risk control should be implemented where possible, with the aim of minimising occupational exposure to hazardous substances.

Key principles are as follows:

- Understand the constituents of drilling fluids and their health effects.
- Understand exposure routes and influencing factors.
- Manage the risks by adopting the standard risk control hierarchy:
    - Elimination.
    - Substitution.

- Engineering controls.
- Personal protective equipment.

2.4.4 Causes of incidents and accidents

The most important objective of safety management is to keep and promote personnel's health and safety. Understanding how and why undesirable incidents and accidents occur and their development is an important factor when planning protective activity (Svenson, 2001).

An incident is a fact that results or may result in material or human loss. It represents a situation in which risk is entered into a system or control of risks is lost. The result will be a damage or loss that may react with a body or material, thus the incident turns into accident. A reaction occurs in case of exposure to a material with energy source above the endurance threshold limit of the body or structure. An energy source may be oil chemical, thermal, sound, acoustic, mechanically, electrical or ionic radiation.

2.4.5 Basic concepts of accident causation

These include:

- Unsafe or substandard actions, which are behaviours, may expose people to risks. (Greaves and et al.1997) found they may typically involve non adherence to safety procedures, impeding safety systems or non-use of suitable protective clothes and equipment to complete work.
- Unsafe or substandard conditions are those that may result in accident and always associated with unnecessary risks or unsuitable control of inherent risks.
- Essential or radical causes are those explaining how direct or nearly-direct causes were allowed. They may be associated with personal factors in which people lose the ability, knowledge or incentive or with business-related factors including poor methods, equipment and organisation (Leveson, 2004).
- Active failures occurring during the period of an accident with direct or nearly miss effect and associated usually with individuals' or equipment failure at factory.

- Latent failures are decisions or work latent in a system for long time and associated generally with individuals not undertaking daily work such as maintenance and operation teams and administrative rotating officials.

2.4.6 Means to control health and safety hazards

Burke (2006) says that organised and planned activity is managed by efficient management with a purpose to control health and safety risks called safety management. In some case, the terms "safety program" and "safety system" are used instead despite that the latter two terms stress less the role of management (Kuusisto, 2000).

Booth and Lee (1995) indicate that the main aim of safety management is to interfere with the causative process resulting in incidents and accidents. This involves active knowledge of the system detecting both visible and latent risks. It is a total system ensuring proper planning and executing of safety activities and arranging follow up system. (Booth and Lee, 1995) state that safety management involves typically such activities as risk analysis, safety training arrangements, accident investigations, near-miss investigations, safety promotion and human reliability. In efficient safety management system, such activities are allocated to different hierarchical levels of organisation.

There are many activities parallel to other organisational management activities. For example, total quality management (TQM) and environmental hazard management have elements similar to those of safety management (Krause and Hidley, 1989) and successful management of health and safety (Wettig, 2002). Developing parallel activities or disciplines and many overlapping management systems are waste of resources. At present, integrated systems of health, safety, environment and quality are introduced in many organisations (Shillito, 1995) in addition to providing prototypes to develop an integrated system (such as BS. 8800, 2004).

In the nineties, several measures, directives, and regulations related to safety management especially in Europe were evolved and applied. The standards BS 8000 issued in 1996 have become the most common general safety management measures while Serves leaflets No. EEC/501/82 of 1982 provides principles for large accidents hazards management in oil and petrochemical industries. The revision stresses control of hazards by improving management system issued in 1996. Finally, the essential requirements of company safety can be considered as a tools for the development of the safety management system.

2.4.7 Occupational accident consequences

Accidents do happen in oil and gas industry as reported by (Robert Bradley, 2013). Three incidents Santa Barbara (1969), Exxon Valdez (1989), and the Deepwater. Horizon (2010) illustrates the oil and natural gas business as not risk-free. Unanticipated, tragic incidents have resulted in very high private and public costs. But the industry has responded to these failures by developing new technologies and improved safety systems. A study by (Robert Bradley, 2013) on U.S. Bureau of Labour Statistics, 2011 shows that there are 2.3 incidents of injury and illness per 100 oil and gas workers. This compares with 3.5 incidents per 100 for the entire private sector. The U.S. offshore industry experienced an even lower rate of 0.8 incidents per 100 full-time workers. In oil refining, the injury and illness rate are reported as 1.1 per 100 full-time workers versus 4.4 per 100 for the U.S. manufacturing sector overall. A comparison of U.S. pipeline transportation data versus the U.S. transportation and warehousing sector shows precisely zero pipeline workers injuries and illnesses in 2011. Meanwhile, the rest of the transportation sector are reported to clock at a rate of 5.0 safety incidents per 100 full-time employees. Data also shows improvements in spill rates. A 2012 report of spill records from 1996 through 2010 finds that offshore spill frequency is actually “relatively low. Spills from oil tankers continue their precipitous decline due in part to the double-hull requirement instituted after the Valdez spill.

2.4.7.1 Types of occupational accident consequences

The cost of annual occupational accidents is high as to lives lost, suffering, and lost wages for workers, damage to production installations and equipment and lost production opportunity. (Simmons, 2002) refers that occupational incidents and accidents always affect the three classes, employees, employers and general management. In respect of employees, they include mental effects, occupational activity effects and economic position effects. Immaterial loses are seldom compensated while the great portion of material losses have coverage by worker compensation system.

Brody and Poirier (1993) said that employer's costs could be classified into protective costs and accident costs.

Three forms of cost can be identified:

1) Fixed costs (safety, equipment and salaries of medical personnel salaries and safety staff).
2) Variable costs (time lost in accident and risk analysis).
3) Unexpected costs (redesign and equipment modification).

Accident costs are divided into direct costs (mainly insurance costs) and indirect costs (resulting from wages, post-damages to materials and management time and production loss). Moreover, there are costs difficult to measure including the damage to general image of a company publicly. This may create difficulties in finding and engaging skilled employees, clients and foreign financial resources. The third party affected by accidents and incidents is represented by general management and consequences of accidents including loss of tax yield and production, costs of public and private services, medical care and retirement-related costs.

Keogh (2000) reports that such figures underestimate the real numbers and costs of work injuries due to lack of complete and accurate reporting of accidents to industrial record-keeping systems. Some studies have investigated the product of waste time and cost of compensation, health, job and family. Cumulative job-related injury disorders reaching the upper limit result in urgent symptoms and difficulty in carrying out simple activity of daily thereby affecting family life deeper even than job loss e.g. common depression and family rupture.

2.4.7.2 Accident frequencies and costs

The rate of oil and gas accident frequencies in European Union is 5.89 per 100,000 personnel. The highest rate is found in south-eastern Asian and African countries. Libya is one of them (23.1 per 100,000 personnel). Death rate in USA amounts to 3.2 per 100,000 personnel (Williams, 2001). These HSE aspect and sub aspects from similar studies when related to HSE in oil and gas Industry are as shown in Table 2.2 below.

Aspect	Sub-aspect
Regulation, inspection and enforcement	• Regulatory compliance • Conformance with OGP guidelines (HSE) • preventing workplace accidents • threat of penalties
oil and gas industrial environment and hygiene issues	• HSE monitoring • hygiene hazards assessment • noise levels • health first aid
Workplace culture	• housekeeping • workforce participation in HSE activities • safe behaviour observation • good health and HSE organisation • improvement in HSE culture • identified current HSE performance • employees' participation in HSE promotions
HSE policy	• display of policy format for all employees in all workplaces • regular review of policy • attendance at HSE course and seminars by line management • participation of management in safety system reviews, HSE issues and incident investigations • distribution of HSE information to workforce
Management responsibility	• workforce understanding management responsibility • interaction between management and workforce • paying attention to HSE matters

	• management of HSE tours • providing suggestions about better workforce HSE practice
Incident follow-up	• incident investigation and improvement action • incident investigation records • compliance with industry standards of incident follow-up incident report by workforce
HSE staff	• job descriptions defines duties required for position • HSE staff in organisation flow chart • Position used as resource by workforce
HSE audits	• Auditors • internal and external audits • carry out audits at regular intervals • involvement of management and workforce at all times in audit process • result and proposed action plans posted on notice boards
HSE training	• existence of need and review of training procedures • training records and schedule training available • professional trainer responsible for training • checking effectiveness of training conducted
Communications and learning	• effective communication process in place • provide relevant information to workforce • the workforce participation in HSE aspect • post conclusion on notice boards
HSE pays	• learning from events • supply of PPE • document management plan exists • availability of emergency equipment • training initial and an ongoing emergency planning
Supply chain pressure	• contracts requiting • government pressures

	• insurance claims • evaluation of contractor performance • contractor feedback • industry association guidelines

Table 2.2: HSE aspect and sub aspects from previous studies related to HSE in oil and gas Industry

2.4.7.3 Monitoring and review

The review on existing data and research on the global distribution of the impacts of oil production and consumption (O'rourke et al. 2003) describes and analyses the environmental, social, and health impacts of oil extraction, transport, refining, and consumption, with a particular focus on the distribution of these burdens among socioeconomic and ethnic groups, communities, countries, and ecosystems. An environmental justice framework is used to analyse the processes influencing the distribution of harmful effects from oil production and use. A critical evaluation of current research and recommendations for future data collection and analysis on the distributional and procedural impacts of oil production and consumption conclude the review.

Monitoring performance of an organisation is a difficult task (Orourke, 2003) because it requires determination of parameters explained the different field of organisation performance better. One particular of safety is that it can't be measured with economic measures. For example, it is frequently difficult to know how to improve investment and increase production and safety (Safety increase profitability). Accordingly, investment in safety shall be viewed as a thing enhancing production increase indirectly by gaining client's satisfaction, improved quality of products and services, better internal efficiency and employees' satisfaction.

Monitoring procedures are divided by health and safety manager into:

- Performance measuring.
- Account audit.

- Performance audit. The model of health and safety manager is consistent with the frame of BS8800 of main activities of safety management except that "performance audit" activity is not included in the measures of BS 8800.

2.5 HSE system management standards

Top management is responsible for all aspects of operation in a company. When the matter is related to health and safety, management should establish policies minimising errors and accidents (Gunnigham, 2004). However, policies alone can't change human behaviour. Proper safety culture is required for employees to work safely and are developed toward environmental changes and learning from errors.

Despite that, managers and other administrators are rarely in a position endangering system safety directly, their main role is to organize people in a way enabling them to cooperate in meeting common goals and hence have a great direct influence. However, there is a great problem in that managers of manufacturing plants and factories tend to have technical backgrounds and are generally suspicious about humanitarian sciences (Lee, 1994). This may result accidents because of human error and for which blame is spread to other operators or employees. Maximum Exposure limit (MEL) UK final regulatory Impact Assessment (after Consultation) on the proposed European Regulation on the classification, labelling and packaging of substances and mixtures (based on the UN Globally Harmonised System - GHS) the bad management is responsible for 85% health and safety problems. This doesn't relieve workers or employees for responsibility for safety but it rather highlights the need for strong leadership by top management.

The existence of successful management of health and safety is a matter related to the existence of works and needs to be an integral part of the day to day management covering all phases of a project (Williams, 2001). This means that it should influence decision making by top management, supervision of plans management and execution of detailed procedures by operators and employees.

In the following sections, we shall discuss in more details measures, systems and regulations of health and safety management.

2.5.1 Health and safety at work act (HASAWA) 1974

Laws related to health and safety at work has been developed piecemeal during the last two centuries. Modern legislations of health and safety started with Factories Act of 1937. It is the law, which preceded Factories Act of 1962. The health and safety at work committee suggested essential changes to the law and management of occupational health and safety. It was decisive in ratifying (Health and Safety at Work Act, 1974) (Stake, 1995). Indeed Health and Safety at Work etc. Act, 1974 HASAWA, which stands for Health and Safety at Work, is a legislative document in the UK which regulates work-related safety and health in the place of work. This Act is enforced by The Health and Safety Executive (HSE). This institution enforces also other requirements that HASAWA has emphasised the control of the risks through management process. The Act requires the engagement of risks by employers within the following framework:

- **Policy** is a first step towards Health and Safety excellence. It is required to develop a policy statement outlining the organisations goals and targets in respect of H and S.
- **Organisation** It is required to have organisational arrangements in place to put in place the policy where the roles and responsibilities of management and workforce are accounted.
- **Administration** It is required to have necessary administrative arrangements, such as internal standards and procedures to enable the policy's goals to be carried out.
- **System** It is required to establish a system to examine the success of the measures taken, to recognize any weaknesses and specify the corrective actions needed.

2.5.2 Health and safety guidance (HSG 65)

Health and Safety Guidance (HSG 65) is a recommended by HSE approach to manage Health and Safety in the working environment. This method is very popular in the UK. HSG 65 is focused at "directors, managers with health and safety responsibilities, as well as health and safety professionals. Employees' representatives should also find it helpful" (HSG 65, 2003). It describes the basis of effective Health and Safety management, addresses relevant issues, and encourages organisational development, Health and Safety improvement. It is not addressed to particular industry or sector and can be used universally. HSG 65 framework consists of 6 key elements as shown in Figure 2.3.

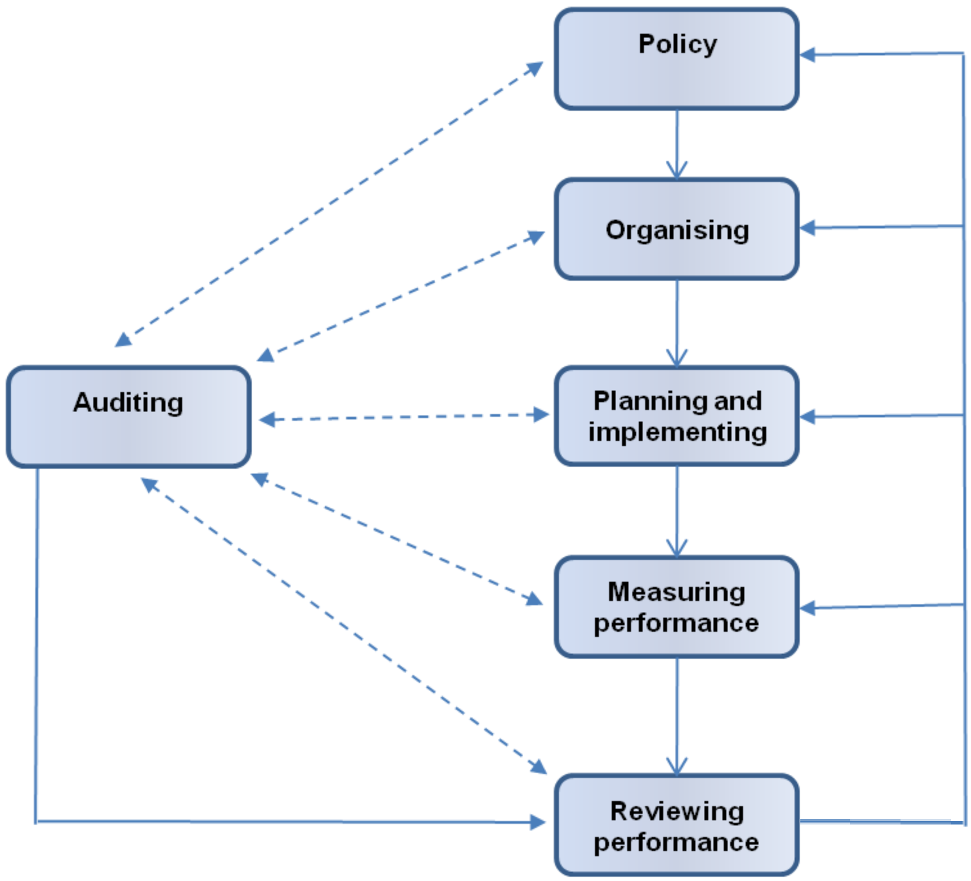


Figure 2.3: Key Elements of Successful Health and Safety Management

Source: HSG65 (2003) Auditing Reviewing performance Measuring performance Planning and implementing Organizing Policy.

- **Policy** that shows the purpose and intents of the company towards health and safety, executives commitment, supports human resource development, recognizes importance of development supportive to H and S culture, ensuring allocation of resources and support of initiatives which would contribute towards continuous improvement.

- **Organising** it is crucial to define the roles and responsibilities, as well as relationships, which will promote H and S culture, and assure implementation and continuation of development of H and S policy.

The guidance promotes 4 Cs of organising:

1. Control by identifying and assigning responsibilities for safety within the organization.
2. Cooperation between individuals: managers, employees and their representatives in the company through encouraging and supporting consultation (the involvement of all levels in safety committees), problem solving of safety issues and incident investigation.
3. Communication of information into, within and out from the organization it can be achieved by visible means, written documents and face-to-face discussions inside the organization. The importance of passing on HSE information to others is emphasized.
4. Competence in the development of the skills, identifying training needs and general health safety and environment promotion.

2.5.2.1 Planning and implementing

Activities to achieve the policy objectives in many ways these two elements are the key of the risk management process. They are about taking the general objectives and drawing up specific plans with allocated responsibilities to reach them. It may be decided to work on a broad front looking at all facets of the organisations activities or to look at a specific aspect that is giving cause for concern. For instance, the organisation may decide to concentrate on risks arising from stress in the workforce. It may arrange instruction on recognising and dealing with stress in the workplace and require department managers and their safety committees to focus on this risk. Within this overall plan the company may decide to draw up a detailed plan which could contain the following specific elements:

- Inform the work group of the objective.
- Provide guidance on stress to members of the work group.
- Develop a stress survey from.

- Arrange for employees to complete the form and analyse the results as follows:
- Arrange feedback.
- Make arrangements to deal with specific employee issue.

2.5.2.2 Measuring performance

By setting time scales for achieving each step of the plan against which performance can be measured. This is an example of proactive monitoring – measuring the performance of a process designed to prevent a hazard causing injury. Reactive monitoring, on the other hand, is a review of lagging indicators such as accident and ill-health data. Both these monitoring techniques can be used to show how effective the risk prevention processes have been and may indicate where additional risk prevention action is needed.

2.5.2.3 Reviewing performance

Refers to a review of the extent to which the policy intention has been successfully achieved through the organising, planning, implementing and measuring phases. Its value lies in gaining an understanding of how well the managements process to control the hazard has worked and what improvements need to be made to the risk control process.

2.5.2.4 Audit

Is an overview across the organisation of the entire risk management's process. It should consider whether the objectives are sufficiently comprehensive to cover all hazards and their effects on all those persons (internal and external) who may be affected. It should include the objectives and management style of the directors and their influence on the safety culture of the organisation. It can use data from the review of performance to assess the strengths of the organisation and those aspects where improvement is necessary.

2.5.3 British standard 8800 occupational health and safety management system

British Standard (BS 8800, 2004) reflects the approach given in (HSG 65, 1997). The latest updated version of BS 8800: 2004, which now includes not only information links, but continual improvement links. (BS 8800, 2004) includes comparison between itself and other standards, such as BS EN ISO 9001:2015., BS EN ISO 14001:2015, ILO-OSH 2007 and OHSAS 18001. This comparison framework is used in methodology to evaluate the HSMM effectiveness and presence of different components in management systems listed above. British Standard BS 8800 reflects the approach given in HSG 65, but incorporates elements of ILO-OSH 2007 (in particular initial status review).

Initial status review: It helps companies without effective HSEM in place to establish the basis for HSE arrangements and relations to managing risks. This can be applied in newly found companies. Mature companies advised to review their status periodically.

Policy: It demonstrates management commitment to HSE. Companies' top management has to make sure company aims to establish continuous improvement, cultural development and adequate resource allocation, as well as recognising HSE as part of successful business performance.

Organising: This element allocates general and management responsibilities; ensures organisational arrangements which promotes HSE integration across the organisation and into all its activities; identifies training needs and establishes effective communication.

Planning and Implementing of risk controls, positive HSE culture and meeting changing demands. It consists of setting objectives, risk assessment and control, compliance with legal and other requirements, designing of management arrangements, implementing and documenting.

Measuring performance: It evaluates implementation and effectiveness of existing arrangements and risk controls. It represents information on current status and progress.

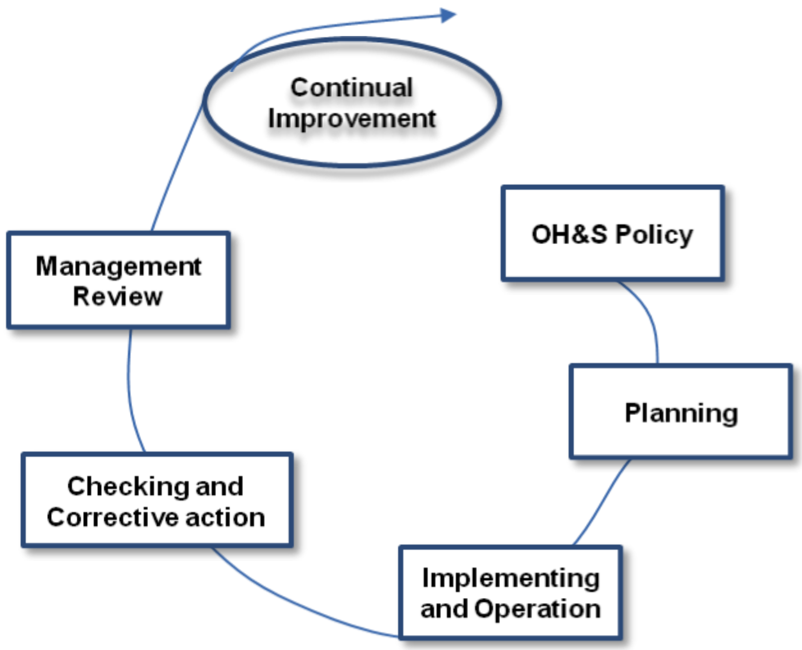
Investigation and response: It analyses performance and identifies common features and trends. Areas for improvement might be revealed and enhanced. It is important to consult with competent persons at this stage.

Audit: It enables deeper and more critical evaluation of all the elements of HSE management framework. To maximize the benefits of audit it is recommended that a competent independent person conducts the audit.

Reviewing performance: It includes periodic status review and management review. These aspects are major drivers for continual improvement. Periodic status review identifies areas of potential changes, shows if organisation achieved its initial goals, compares own performance with similar companies in the industry. Management review is aimed to assess if management system is suitable, adequate and effective (BS 8800, 2004).

2.5.4 Occupational health and safety assessment (ISO18001, 2015)

Occupational Health and Safety Assessment Series (OHSAS, 18001) is an international standard, which is used for managing occupational safety. It was developed to satisfy the need of industry for a benchmark, against which companies could compare their performance. Organisations can assess their management systems and get a certificate. OHSAS 18001 uses model shown that consists of 6 elements shown in Figure 2.4.



Source: (OHSAS 18001 2007)

Figure 2.4: OHSAS 18001

The Standard is established on the technique known as Plan-Do-Check-Act (PDCA). PDCA consists of:

- **Plan** – establish the objectives and processes necessary to deliver results in accordance with the organisations HSE policy.
- **Do** – implement the process.
- **Check** – monitor and measure process against HSE policy, objectives, legal and other requirements, and report the results.
- **Act** – take actions to continually improve HSE performance. OHSAS18001 framework consists of 6 elements:

OHS policy is defined and authorised by top management. It should be appropriate to the character, history and scale of the organisation's HSE risks, dedication to prevention of injuries and continual managerial improvements and performance; it should provide framework to setting and reviewing HSE goals and is reconsidered periodically.

Planning: It focuses on hazard recognition and classification risk evaluation and controls determination compliance with legal and other obligations, establishing HSE targets at all organisational levels.

Implementing and operation: It shows management commitment by allocation resources, assigning roles and responsibilities which have to be communicated and documented. This element ensures all employees are trained, competent and aware of HSE status of the company and their roles within it. At this stage proper communication, participation and consultation is established; required documents shall be controlled; emergency situations are assessed and response plans are in place.

Checking and corrective action: It includes performance appraisal, quantification and monitoring, estimation of compliance, incident analysis and identification of areas that do not match the requirements. Remedial and preventative actions should be taken if necessary. The organisation should ensure effective internal audits are in place.

Management review: Senior executives have to re-evaluate the organisations HSMM, at regular time periods, to guarantee its consistent suitability, satisfactoriness and efficiency. After the examination possible changes might be taken to enhance HSE performance, policy and aims, assets or other HSMM (health safety management model) elements.

2.5.5 ISO 9000 quality management

Some companies adopt international quality management standard suggested by International Organisation for Standardisation (ISO 9000) as the approach for Health and Safety management. It is a European standard, but is ranked and recognised as British standard as well. The standard lists eight quality control elements that should be used by organisational leaders in order to direct organisation into continuous improvement cycle. The principles of this management system are:

1. Customer focus.
2. Leadership.
3. Involvement of people.
4. Process approach.

5. System approach to management.
6. Continual improvement.
7. Factual approach to decision making.
8. Mutually beneficial supplier relationships.

This approach is complex and includes such elements as stakeholders (customers and other interested parties), consideration of their requirements and need satisfaction, and resource management. In this way the system addresses not only internal organisational environment, but also takes into account external factors as well.

2.5.6 International safety audit system (ISA 2000)

ISA System of 2000 represents an approach to safety management not by legislation but via good management practice. The cause is simple. Legislation of safety depends on good practice. However, not all good practices are included in legislation. It is natural that good practice is used as a starting point for more comprehensive and efficient control system. Accordingly, an organisation adopting the approach of Industrial measurement engineering of 2000 (HSG 65) represents a monumental system built on good practice. After doing this, a comprehensive revision is made for effective legislation to ensure the inclusion of all legal obligations.

International Safety Audit System (ISA 2000) includes a set of initiatives containing 200 elements classified into classes, mandatory and complementary. Volume 1 includes the mandatory elements to be executed as part of the occupational safety management system for any company. Mandatory elements are selected to provide controls against general risks confronted at workplaces, small or large. They reflect the minimum limit of adherence to the main safety law. For companies operating in non-dangerous environment, these elements may be sufficient.

Volume 2 includes a number of additional elements. For many companies, it is necessary to include several systems whether because they become part of safety management system or because they are additional control systems for companies considering them essential to execute safety management system on a wider scale.

ISA 2000 doesn't include any new or creative control system from the perspective of special risks. However, it provides a practical approach enabling managers to organize current safety efforts and provide them with means ensuring spreading of rare materials. Hazard Communication involves hazardous materials by auditing question: Does employer have a written Hazard Communication Program (HCP) and uses Material Safety Data Sheet (MSDS) in most efficient and cost-effective way?.

This approach can be applied internationally. It contains no indications to certain items related to national legislations. It contains a general direction to abide by obligations applicable to nine sections as follows.

- Organisation and management program.
- Hazard evaluation analysis program and procedures and safety rulers.
- Personal deduction program safety training and awareness.
- Inspection program and risk reporting.
- Accident management program and corrective action.
- Emergency planning program and response.
- Change control: Design, purchase, suppliers and control of employees 'protective supplies.
- Physical conditions.
- Compliance with legislations.

2.5.7 HSE rating system

There are currently two main safety rating systems: the International Safety Rating Systems (ISRS) and the British Safety Council Five Star Audit, (BSI, 2004).

British Safety Council UK as developed by DNV in 1978 has 14 elements, 126 sub-elements, 650 requirements at 10 levels. ISRS elements are as below:

- Leadership and administration.
- Leadership training.
- Planned inspections and maintenance.
- Critical task analysis and procedures.
- Accident/incident investigation.

- Emergency preparedness.
- Rules and work permits.
- Accident/incident analysis.
- Knowledge and skill training.
- Personal Protective Equipment.
- Health and Hygiene control.
- System evaluation.
- Engineering and change management.
- General promotion.

In respect of the Five Star Audit System, the following steps are required:

- Assesses management and staff practices.
- Measures safety performance.
- Recommends courses of action.
- Encourages continuous improvement.

Its aim is to help evolve courses of action suggested to prevent accidents and injuries. Thus Five Star Audit is a comprehensive system that involves conducting a detailed examination of the premises to identify all areas of potential risk and loss. It includes 82 key elements in 5 major areas shown in Table 2.3.

Safety Area	**Score**
Safety organisation	26
Management control systems	26
Fire control systems	12
Measurement and control systems	6
Workplace implementation	12

Table 2.3: The Five Star Audit System: Safety Area versus Score

Maximum marks allotted for each to each element are as shown in Table 2.4 with a grand total is 5000 Section Audit criteria Maximum accredited audit. Total: 5000 Points

1	Policy and Organisation	750 Points
2	Strategy and Planning	1125 Points
3	Implementation and Operation	1500 Points
4	Performance Measurement	1125 Points
5	Evaluation and Review	500 Points

Table 2.4: The Five Star Audit System: Distribution of scores

The Five Star Audit system has Grading System shown in Table 2.5.

92% - 100%	Excellent
86% - 91.9%	Very Good
75% - 85.9%	Good
60% - 74.9%	Average
50% - 59.9%	below Average

Table 2.5: The Five Star Audit System: Grading System

The Five Star Audit is audit conducted using the British Safety Council's numerical safety grading system Source: (British Safety Council Five Star Audit Specification Document 2013).

The five sections of the audit are divided into sixty six (66) elements which attract a maximum numerical value of 5000 points. Several of these elements are considered as "core" to the relevant section. Some of these core elements are also applicable within more than one section.

2.6 HSE audits

In this section, existing Health and Safety management models are compared through single framework, based on approach introduced in BS8800. The models being assessed are HASAWA 1974, HSG 65, BS 8800, BS EN ISO 9001, BS EN ISO 14001 and OHSAS 18001 as shown in Table 2.6 below.

Element	HASAWA 1974	HSG65	BS 8800	BS EN ISO 9001	OHSAS 18001
Initial status review	-	-	+	-	-
Policy	+	+	+	+	+
Organising	+	+	+	+	+
Planning and implementation	+	+	+	+	+
Performance measurement investigation and response	-	+	+	+	+
Audit	-	+	+	+	+
Reviewing performance	-	+	+	+	+
External environment	-	-	-	+	-

- NO
+ YES

(Source: adopted from BS8800, 2004)

Table 2.6: Comparison of Health and Safety Management

As it is seen from the Table 2.6 not all of the HSEMs include all elements in so far as BS 8800. All other models miss some of shown in the table elements. The table is adopted from (BS 8800 2004), but the element "external environment" is added to emphasize, that BS EN ISO 9001 take into account customers and other interested parties requirements and satisfaction, which is external factor that other management models are missing.

2.6.1 Measuring performance

Evaluation of safety system requires two measuring systems (HSE, 1997). The first, which is the active system, monitors the design, development, installation and operation of management arrangements, risk control system and workplace arrangements. The second system which is the reactive system monitors accidents, incidents, diseases and other deficiencies in health and safety performance.

According to (Diekemeper and Spartz, 1970) active systems are designed such that they measure the quality and quantity of safety activities while reactive systems are designed to measure results or performance.

According to health and safety reports (HSE, 1997) such systems include different kinds and levels of active monitor:

- Routine procedures of special targets monitoring such as quarterly and monthly reports.
- Periodic inspection of documents to ensure the situation of health and safety promotion systems such as the documents setting out targets of each manager.
- Methodological inspection of offices, factories and fittings by different persons at the level of supervisors and line management.
- Environmental control and health monitoring to ensure health control measures.
- Operation of audit and accountancy systems.
- Follow up of health and safety reports by top management. Starting operation of reactive systems after incident occurrence.

They include identification and reporting (HSE, 1997):

- Other losses such as property damages.
- Accidents including those that may result in diseases, injuries, loss.
- Weakness or deficiencies of performance measures.
- One strategy is to put a lot of effort into reducing minor accidents – because there of fewer intermediate accidents and even fewer major ones.

2.6.2 Safety audit

This involves:

- Check and affirm system effectiveness.
- Carry out structured checklist by Multi Disciplinary Teams.
- Internal Audit - Every Year.
- External Audit (once in 2/3 years) and Surprise.

- Pre-commissioning safety audit.
- Implementation of recommendations.
- Unit Head/Divisional Director/Board of Directors.
- Statutory Review Compliance.

The HSE management system, compliance of Libyan and following international rules are mandatory according to the following regulations:

- Nigeria, The Factories Act, 1987.
- India, The Petroleum Rules, 1976.
- India, The Gas Cylinder Rules, 1981.
- India, The SMPV (U) Amendment Rules, 1999.
- India, The EP Act, 1986 and other relevant rules like Libyan Electricity Act, Boiler.
- India, Regulations, Central Motor Vehicle Rules etc. to be followed.

2.6.3 Carrying out audits

The International Organisation for Standardisation defines auditing as a systematically independent inspection to determine how compliant company activities are with the scheduled arrangements and to know whether or not such arrangements are executed efficiently and consistent with the targets attained.

Health safety and environment inspection is a process of collecting independent information on the efficiency, effectiveness and reliability of the whole health and safety system and establishing plans for proper correction procedures (HSE, 1997). Moreover, auditing supports monitoring by providing managers with information on the methods of successful planning and execution in respect of health and safety components. It provides risk monitoring system that ensures the sufficiency and effectiveness of management rearmament (Kamaz, 2005).

Auditing can be used in several different conditions. First auditing serves as the base for establishing safety policy and program. In the British standard 8800 of (2004) this activity is called initial status review. Similarly, safety inspection is carried out to ensure compliance with the requirements of safety policy and program. Reviewing Performance review is the decision making process on the works necessary to eliminate deficiencies. (Cooper, 2000) concludes that responsibility of top management needs to be practical to evaluate performance sufficiency. The review effects the safety policy of an organisation and its strategic objectives.

British standards 8800, helps derive review-related information from measurement system and audits. Measurement system provides information on safety results. Audit provides information of the way with which pre-determined safety activities have been carried out and associated problems noted.

2.6.4 HSE management audits

HSE audit evaluates the HSE status of a company, HSE policy, HSE organisation and execution of HSE activities and its performance measurement system according to the British standards (BS 8800, 2004). Bearing in mind the size and nature of company activities, one field or more of HSE management system fields can be evaluated during the same audit.

Different persons in the organisation do conduct a HSE audit in several ways covering several economic activities. More often, it is called in the daily practices risk analysis, technical inspection operations and routine evaluation of level. (Glendon, 1995) said that if safety audit is understood as similar to quality audit system, then it is considered as an evaluation of management system. Such an evaluation has two goals: ensuring compliance with the minimum legal requirements by treating HSE efforts as efficient and sufficient.

Moreover, audit should include individual interviews with employees, documents review and visits of workplaces. For auditors desiring to generalize audit, several quantity auditing tools have been developed. These tools can be used to follow up progress of company and in some case to compare activity levels among different companies.

2.6.5 Audit in oil and gas related HSE management systems

Successful health safety and environment management in oil and gas industry requires commitment to a policy and program of continuous improvement, together with a regular audit and review of that program.

Auditing is the structured process of collecting independent information on the efficiency, effectiveness and reliability of the HSE Management System. It provides a measure of progress and the mechanism to draw up action plans for continual improvement. Health, safety and environmental audits are a means of demonstrating an organisation's compliance with its declared objectives, legal requirements, as well as benchmarks towards excellence in health safety and environment.

As with any investigation process, it is essential that the recommendations, which are the outcome of the audit, are fully addressed and acted upon. All actions should be formally addressed by the senior manager and either accepted or rejected in writing. In the latter case the reasons should be stated.

Auditing involves measuring the performance of personnel as well as compliance with systems of control. The following three groups should be audited.

Senior management should be evaluated on awareness, commitment and leadership in the local HSE program principles.

Middle management should be evaluated on the details of the local procedures and systems relating to HSE management.

The workforce understanding of health and safety and behaviour should be evaluated; findings serve as useful indicators of the level of compliance with procedures and practices and as evidence of management leadership and commitment to HSE protection.

HSE auditing and evaluation is part of the process of continuous improvement, leading to a performance review, which may indicate that certain areas require improvement. For the review part of the process to operate efficiently, the recommendations must be meaningful, with a realistic time-scale and specific assignment of responsibility for corrective action.

The report must be formally accepted and the recommendations endorsed by the senior manager to provide the necessary impetus to the implementation process. Once the audit report recommendations have been accepted by the senior manager, arrangements should be made to develop an implementation action plan. At this time a review should be carried out of the existing HSE policies and programs and any necessary revisions made. The HSE audits are carried out in respect of both operation base and rig site.

Audits at Operational Base involve:

- Review of procedures and manuals.
- Audit of HSE records from different rigs.
- Interview of HSE team and management.

Audits at Rig Site involve:

- Inspection of HSE Equipment.
- Inspection of HSE features of critical equipment.
- Audits of rig records and interview of rig crew.
- Audit of HSE practices and effective implementation of procedures onsite.

Benefits and Advantages of Audits in oil and gas Industry:

Audits help to identify:

- Better controls to eliminate inherent hazards and risks.
- Individual or collective measures that will be instrumental in preventing work related accidents and injuries, thereby, safeguarding the health of workers, encourage their motivation and productivity, reduce cost for treatment, rehabilitation or compensation and raise the profitability.
- Ensuring that procedures are effectively implemented.
- Occupational Health and Safety (OHS) a check list of 1000 control items.
- Generating audit report and check list of action required.
- Reliable conformance level based on exhaustive HAZOP studies.
- Clarifying non conformities related to management support.
- Meeting ISO 9001, ISO 14001 and OHSAS 18001 requirements.
- Preventive Maintenance System.
- Preventive Maintenance Audit at Operational Base relate to:
- Review of maintenance routines, manuals and records.
- Audit of spare parts supply and management of minimum stock.

- Review of current planning of major maintenance jobs.

Preventive Maintenance Audit at Rig Site relate to:

- Audit of maintenance records, especially running hours and overhauls.
- Inspection of effective maintenance performed on main equipment.
- Inspection of rig stores and critical spare parts.
- Analysis of rig downtime and repetitive curative maintenance.

2.6.6 Safety auditing

It is an orderly way to evaluate safety management system of a company covering the whole system. It is part of the general activities of company and procedure similar to audit of environmental and quality management systems (Kuusisto, 2000).

2.6.7 Authority control and internal auditing

Fairman (1999) indicated that safety legislations have been found for hundreds of years. In 1773, sea coal was prohibited to be sold in UK because of its polluting emissions. The first inspectorate in the world was established in 1883 in UK. An occupational safety organisation control was developed in early 20th century when the first worker compensation laws were introduced. The first main legislation was developed when risks and hazards were perceived. Health and safety law came to existence in USA in August 1971 and occupational health and safety management was set up in the same period. The occupational health and safety law was the first safety program promoting inspection operation. (Douglas, 1993) stated that enforcement was used as a preliminary method to follow up personnel as to meeting the minimal obligation.

It was found that in addition to equipment, unsafe behaviour of people contributed to accidents. Hence, it was clear that enforcement approach was not suitable. (Ferry, 1990) said that since mid-eighties, the occupational health and safety act stressed programs promoting the improvement of unsafe conditions and human behaviours.

The improvement of safety control systems was similar in Europe and USA. Up to the first years of 1980s, safety at work was promoted mainly to meet legal requirements and the main duties of safety authority were to follow up safety investigations detailed at workplaces. In seventies, European countries introduced legislations pertaining occupational health care including regular on-site analysis. In 1989, the instruction of framework 89/391/EEC of the European Union obliged employer to draft a safety program describing how to control the effect of health and safety on work environment. Now, they seek adjustment with national legislations of member states to the EU.

In the nineties, safety management systems were introduced on a wide scale in USA and Europe and the concentration shifted from authority control to internal control of risks. (Robson, 2002) said that the role of safety authority is to shift from the role of inspector to the role of advisor who participates in developing safety activities in the company.

Auditing performs a clear task in improving internal risk controlling systems of a company. Audit is a way explaining to authorities that the company efforts are sufficient and efficient. Moreover, audit is an efficient operation to find activities requiring improvements. Administration review is a procedure evaluating audit and determining new activities and safety goals.

In such a situation, safety authority can act as external safety auditor. For example, the enforcement commissioner or administrator of health and safety Executive in UK (HSE, 1997) and Labour Inspectorate in Belgium, established audit system with special authority and recommended companies of the way to enhance and run successful safety management system. Safety authority audits can be viewed as useful too given that authorities is more familiar than others with the legal requirements.

2.6.7.1 Basis of auditing theory

According to (Labonete et al.1993) auditing is a typical evaluation activity while organisational assessment is a process measuring the efficiency of an organisation from the perspective of a social and behavioural system.

Organisational assessment has three elements:

1. Organisation to be assessed and its personnel.

2. Assessment team and theories and measuring tools used in collecting information.
3. Staff who receives and use assessment results and who provides the resources for executing suggested activities. The main fields of organizational assessment includes stakeholders, suppliers, consumers, supplies, individuals, sets, formal organisational arrangements, informal organization, surrounding environment and results of self-oriented, relation oriented and task oriented behaviour.

Cooper (2000) said that any management system should be able to identify, evaluate and estimate company problems to provide relevant recommendations. However, audit can't solve all problems. He added that in spite that audit could identify the most hazardous problems, it couldn't determine all problems irrespective of the type of audit used and the item it stress such as quality, safety and environment.

Some measures give general guidelines to plan and execute audit. For example, the International Organisation for Standardisation (1-10011) is referred to quality audit:

1. Determine compliance or incompliance of quality system elements with certain requirements.
2. Identify effectiveness of quality system executed in meeting assigned goals.
3. Provide a chance for auditing officer to improve quality system.
4. Ensure fulfilling of organizational requirements.
5. Allow registration of organization quality system that has been audited in the register.

Kuusisto (2000) stated that approval is not common with a system as in the quality management system. This situation is changing as companies become able to oblige themselves to the responsible care program and third parties organisations will undertake approval of safety management systems.

2.6.7.2 Safety auditing types

Some people use wider definition of safety auditing including nearly all safety management activities while others adopt approaches stressing more on the technical aspect:

- Quality audits of certain subjects such as human factors and risky materials.
- Technical audits of factories including reviewing its operations carried out by specialised employees.
- Audits of site covering special business tasks carried out by local and specialised employees.
- Audit or verifications to prove if the legal requirement are met.
- Validation audits dealing with the scope and design of audit and stress for example whether proper types of subsystems are adopted and whether proper types of monitoring methods are used. They include management safety audit.
- Management (or safety) audit covering the general safety issues and requiring local employees and perhaps local auditors too.

2.6.8 Management safety audit tools

Petersen (1998) said that the first tools developed to evaluate safety management systems were checklists which verify audit in the form of yes/no questionnaire and complementary and complicated audit tools as a second step. Audit tools are represented by a list of safety activities requiring evaluation and evaluation standards. Activities are typically classified under titles such as "organisation", "risk control" and "reporting". Health and safety authorities, consulting companies, universities and other research institutions develop safety audit tools. (Dikeemper and Spartz, 1970) developed a tool in early 1970s. Since then, several tools have been developed such as ISR, Chase (Glendon et al, 1995) safety map (1995).

The responsible care program for risk management in chemical industries guidelines related to safety audit and protecting occupational health and environment in 1992. It is an example of a partial method of health audit. All quality granting programs assess some fields of safety management (concession execution standards, 1999), (Consultant, 2003).

Following is a summary of comprehensive four comparison tools including safety management audit. One of which is a method of safety audit for general purposes while the rest are designed mainly for use in industrial workplaces. The selected tools are traced back to several time periods from 1970 to 1997.

2.6.8.1 The Diekemper and Spartz methodology (1970)

According to (Petersen, 1998), this method was developed to measure the nature and level of efforts exerted to control industrial accidents. It consists of three parts:

1) activity measures 2) assessment model 3) summary sheet of final result calculation. Each activity is assessed according to four-level scale (weak, acceptable, good, and excellent) and providing a standard list for each level.

The tool of Diekemper and Spartz is a measure assessing activity instead of measuring results or performance because activities level and nature can't be translated in all cases into equivalent results (Diekemper and Spartz., 1970). Moreover, it is possible to control safety results as expressed in risk assessments and frequencies to some extent.

It is possible to establish an objective method to measure both quality and quantity of safety activities and determine at the same time how to achieve good risk control. This method should meet the following standards:

- Measuring apparatus should be standardised.
- Studied activity should be structured in a way allowing its establishment.
- Assessment technology should be designed such that it allows line managers to connect their activities with measures (Diekemper and Spartz.1970).

This method was used in two studies at least. The method was applied for small and medium-sized companies (Kakriainen and et al., 1992). However, the reliability and validation of that method were not evaluated in these studies. (Malten, 1981) conducted another study that evaluate the validation of the method in 12 companies (Kuusisto, 2000) and addressed the following fields of activity:

- Organisation and management.

- Industrial risk control.
- Industrial health and fire control.
- Supervisory participation, incentives and training.
- Accident investigation, statistics and reporting.

2.6.8.2 Complete health and safety evaluation (CHASE)

Complete evaluation of health and safety (CHASE) is a method developed in UK with the contribution of industrial, academic, health and safety authorities. Version 1 was addressed to medium-size companies while version 2 was addressed to large company having 500 employees or more (CHASE 1, 1989 and CHASE 2, 1989; Hess, Kathleen, 1997).

CHASE is comprised of 12 sections (CHASE 2) or to 4 sections (CHASE 1). Each section includes a set of short question. Yes answers are given 2-6 points depending on the activity evaluated and no point is given to No answer. Some question may be set aside, if they are not related to the company such as the case in which a company doesn't store chemicals at the site. The total points of each section and of activity are calculated. Case includes some guidelines to auditor such as definitions, clarification and a list of relevant legislations.

When developed, CHASE 2 was tested in the transport industry where audits were conducted in 9 situations in 1990 and follow up audits were carried out after a year since then. Improvements in all sections were recorded for CHASE 2 as a result of the work completed between the two periods of inspection. A summary of audit scores was also produced for each site showing a range from 18% to 70% and (average 52%) (Glendon, 1995).

CHASE 2 included 12 sections covering the management of:

1. Legal requirements and recourses.
2. Tools, equipment, fixed items and accessories.
3. Machines and factory.
4. Oil and gas, chemical and other substances.
5. Energy.

6. Health.
7. People.
8. Control and feedback.
9. Change.
10. Special emergencies.
11. Vehicles.
12. Tasks.

CHASE 1 for medium-sized organisations concentrates on the following management divisions:

1. Organizational aspects of health and safety.
2. Physical environmental aspects.
3. Petroleum hazards and other health issues.
4. Less common risks.

2.6.8.3 International safety rating system (ISRS), eighth edition 2009

It is an audit system first published by (Frank Bird, 1978) and introduced for the first time in 1978 by the Chamber of Mines in South Africa. It contains a number of short yes/no questions and contains 20 elements. According to (Guastello, 1993), each individual elements and the total of activity can be calculated by answering questions.

The international safety rating system is tested in several studies. (Pringle and Brown, 1990) study reports that 12% of accident occur among 2395 companies in North America by international safety rating system during the period 1978-1979. In another study, (Eisner and Leger, 1988) finds no correlation between the rate of international safety rating system and accident product. (Guastello, 1993). It concludes little support of the view that international safety rating system (ISRS) is an efficient means to control accidents. But, he refers to the useful effect of that method if more sensitive statistics become available.

Bartholomew (1993) refers to experiences in using international safety rating system in oil industries and large-sized chemical factories. For successful application of international safety rating system, it is necessary to: respect local culture of location, assign time for discussions and comments, support efforts of local management, allow participation of maximum number of managers in audit and avoid routine in the operation. Moreover, Bartholomew suggests the development of some aspects of HSE management, including change management, emergency response and risk analysis in international safety rating system.

International safety rating system consists of the following elements:

1. Organization and management.
2. Planned inspection operations.
3. Accident investigation.
4. Organizational rules and regulations.
5. Personnel training.
6. Health control and services.
7. Records and reports.
8. Accident and facts analysis.
9. Emergency preparedness.
10. Work analysis and IT procedures.
11. Group meetings.
12. Employment and hiring.
13. Control and purchase mechanisms.
14. Program evaluating systems.
15. Personal communications.
16. General promotion.
17. Safety outside work.
18. Auditor library.
19. Personal protective equipment, and
20. Hiring and placement.

2.6.8.4 Safety management achievement program (safety map 1995)

Safety map is developed by the Safety and Health Organisation in Victoria, Australia, and issued for the first time in 1994 and revised in 1995. Safety map provides a framework assisting an organisation to build its health and safety management system.

As safety map has been developed recently, with no supporting reliability or validation studies to address it.

Safety map includes a feature called achievement certification with three levels built on audit conducted by the company. The three levels are: 1) primary level 2) transitional level and 3) advanced level. At the first level, a company should meet one third of audit standards i.e. meeting legislative requirements, and creating an integrated system for health and safety management. At the transitional level, two thirds of standards should be met. To satisfy this level, a company should have well-developed safety culture and achieve good safety results. A company may get an achievement certificate by subjecting its health and safety management system to independent audit. This certificate is delivered in Australia by the H and S Organisation (Safety Map, 1995). The safety map consists of the following elements:

- Build and support obligation.
- Document strategy and purchase.
- Work safety system and standards control.
- Reporting and deficiency correction.
- Management movement and materials.
- Data collection and use.
- Management 2 systems review.

2.6.9 Integrated HSE management system

All the elements of HSEMS described above need to be integrated as shown in Figure 2.5.

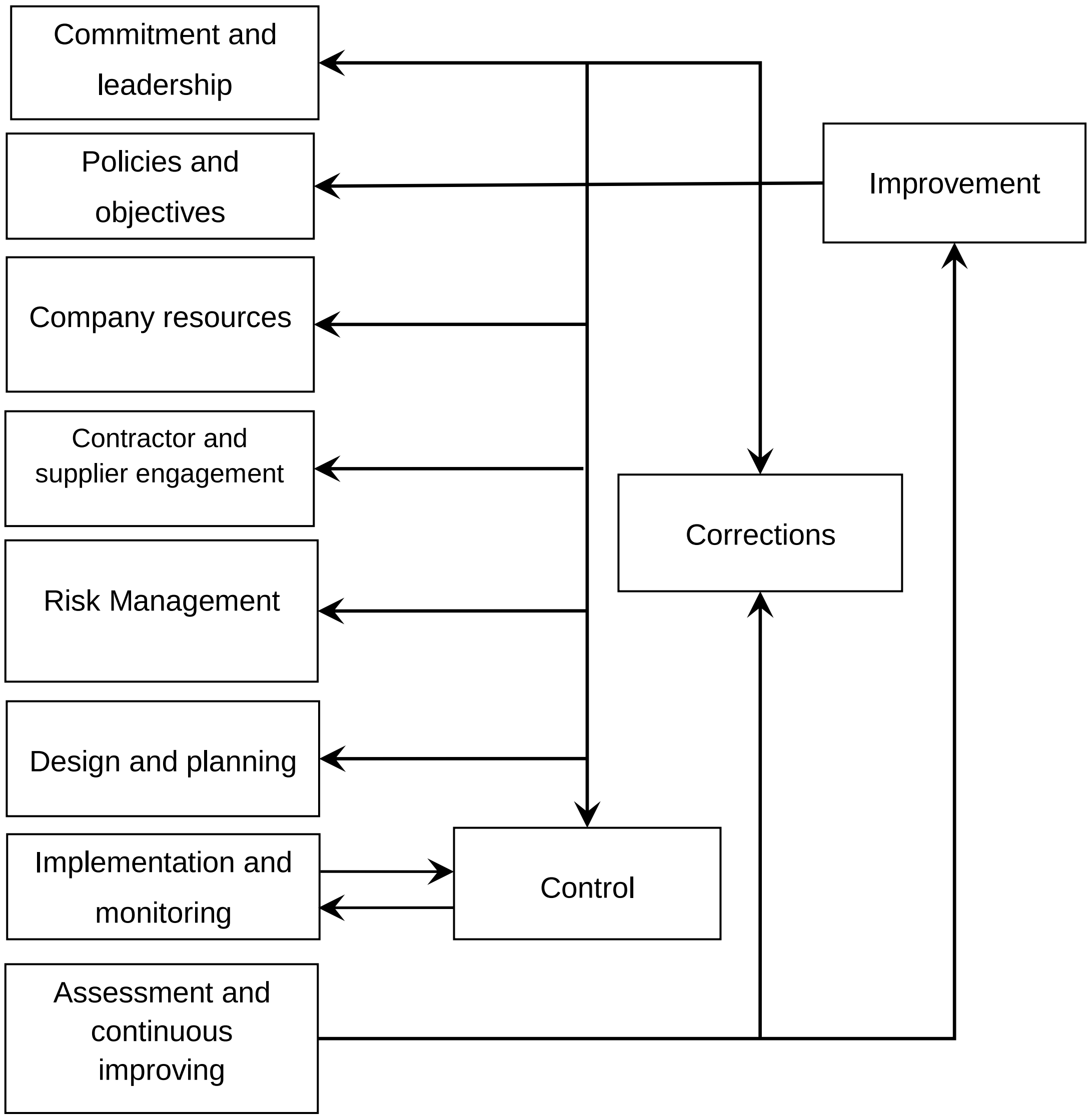


Figure 2.5: An Integrated Typical Management System for HSE

2.6.10 Discussion of current safety audit methods

Auditing methods above mentioned evaluate both of the quality and quantity of safety activities. It wasn't possible to find specifications determining weight despite that the three methods give weights for each stable activity. Weighted values of Diekember and Spartz are not permanent and need to be revised and changed to reflect progress achieved (Diekember and Spartz, 1970).

Whilst the oldest method (D and S) method give little weight to organisation and management and a lot of stress on risk control, CHASE and international safety rating system support the importance of management activities. CHASE paid little attention to behavioural safety of safety leadership and worker motivation for safe work practices. Diekember and Spartz method and international safety rating system give much weight to these activities. Finally, international safety rating system stresses follow up of safety results. Old audit tools stress more on risk analysis and other risk control activities while new methods give more weight to the safety policy, safety, organisation, management and follow up.

A scientific study including validity is conducted by international safety rating system method alone. In all studies, accident records are used as a reference with the different results of validation studies. Some studies show low rate of accidents among users of international safety rating system while other studies didn't prove any correlation. On another hand, health studies using not easy to be carry out safety audits as accidents are not necessarily correlated to safety activities. Correlation finding requires at least conducting tests in a considerable number of large-sides companies and longer time for follow up. In companies with low accident rate, accident rates may not be useful at all in validity considerations. However, validity studies remain important as they are decisive to know whether safety activities measured in fact have effects on safety results of company.

It is clear from the above introduction that CHASE is a method requiring comprehensive understanding of occupational health and safety systems while Diekember and Spartz method used by skilled safety professional employee without a special training. International safety rating system are used only by trained specialised employees. According to Safety Map Manual, safety map is considered as a packet "Do it yourself". As safety map contains small number of laws, is executed by just skilled audit.

2.7 Critique of HSE management literature in the oil and gas industry

Measuring performance is an important matter as reflected in the achievements of health safety and environment performance and management. Measuring if not just as an operation should be continuous operation. This is, a normal function of management. It should be managed by the same method used by any efficient system to collect information about production and cost. It is good to draft performance goals such that they can be properly coordinated and known to people involved. Literature shows that there are several methods used to produce performance measures. Health safety and environment management can be measured comprehensively using performance indicators derived from different performances at the oil and gas industry workplace. Such indicators are typical for incidents in undefined management control mechanism. This is not meaningful in the structure of management system.

In the field of health safety and environment, audit is considered a relatively recent methodology (Bernard, 2000). This is why audit is still the subject of concentrated development. It is clear that some practices of quality audit can be applied to HSE audit but the first is applied directly. HSE audit requires audit evaluation to ensure compliance with the relevant legal requirements. The majority of quality audit doesn't include this aspect. HSE audit requires that an auditor should be sufficiently familiar with relevant legislations.

The majority of audit methods in respect of industrial companies have been developed in recent past. It is not known if such methods are suitable for oil sector too. Generally, validity of audit method is not clear. One of the methods discussed by this Chapter is international safety rating system which is the only method used on a wide scale and its validity has been approved to some extent.

Audit methods described in this Chapter stress HSE risk management that may result in causalities but task oriented, relation oriented and self-oriented behavioural aspect of personal management by leadership and incentive has not yet been addressed by researchers. Moreover, supervisor's evaluation and line management responsibilities for solving mental and social problems of these methods were overlooked totally.

Integration of current performance indicators into audit facilities concentrating on the management structure produces a series of arrangements for conformances to standards and guidelines of HSE management. These conformances if not followed are viewed as radical causes that can constitute sequences of management failures.

Audit facilities show that non-conformities indicated by the measured values of performance indicators were associated with HSE management system. This indicates that performance indicators measured in companies were non-conforming. It is thought that company performance can be improved if such arrangements are dealt as per the requirements of standards and guidelines so that the control of HSE management system can improve.

It is not possible to give a judgment on the non-conformities of HSE management system based only on the data representing company failures and on the number of corrective operations defined at the site. This is because large number of corrective operations at the workplace may refer to strong structure of management control even if they require much correction. And the low number refers that fewer items require improvement but in some cases it indicates that management becomes less vigilant.

Selection of performance indicators is an important matter particularly as to using audit to define proper performance indicators used in HSE management system requiring improvement. Several unsafe acts at the workplace have been identified and evaluated as being less than optimal. It is not easy to say that the low number of unsafe works is the result of improvement in a given field. In some cases, auditor can't demonstrate whether or not the matter is related to misreporting e.g. determining if detailed inspection operations have been carried out regularly.

2.8 Chapter summary

The chapter presents various aspects and sub aspects related HSEMS relevant to Libyan oil and gas sector from review of literature. Review of HSMM and HSEMS has helped in learning lessons from good practices like: OGP Guidelines, HASAWA framework; HSG 65, Successful Health and Safety Management; British Standard BS 8800; Occupational Health and Safety Assessment Series OHSAS18001 and international quality management standard ISO 9000. This involves identifying their philosophy, elements and general working principles. The guidelines, models and frameworks are compared based on presence of elements in their processes. The existing OGP Guidelines, HSMM and HSEMS are found to be deficient in HSE aspects and sub aspects especially in regard to their complexity of procedures, difficulty to interpret and implement, and amount of resources required, especially for domestic medium and large oil and gas companies operating in Libya.

Review shows Libyan Oil and Gas industry faces special risks associated with:

- Highly flammable material
- High temperature/pressure
- Corrosive /reactive
- Self ignition from leakage from system
- Uncontrolled process reactions
- Loss of containment/accidental releases

Libya needs followings as change management for enhanced performance of oil and gas industry by:

- Evaluate potential impacts, authorising and control of changes in process technology, equipment, instrumentation and procedures
- Proposed changes to be reviewed by related functions/departments
- Operation/maintenance personnel are to be trained on changes
- Documentation and communication to all concerned

Chapter 3: HSE CHALLENGES IN LIBYAN OIL AND GAS INDUSTIRES

Different HSEM systems and strategies used by different oil and gas companies from various parts of the world that are operating in Libya use a variety of terminology. The key terms used in this thesis are defined in Appendix A. The problems in respect of HSEM System for the oil and gas sectors in Libya described in this research pertain to 7 elements:

1) Leadership and commitment.
2) Policy and strategic objectives.
3) Organisation, resources and documentation.
4) Valuation and risk management.
5) Planning.
6) Implementation and monitoring.
7) Auditing and reviewing.

This chapter aims to review HSEM management issues in oil and gas sectors in Libya. The objective is to identify and define the critical factors that may influence HSE performance improvement. This chapter also discusses norms, laws, rules and regulations being followed by various operator companies in oil and gas sector of Libya in respect of HSEM.

3.1 Background about the Libyan Oil and Gas Industries

This section outlines a brief history of what happened in Libya before and after the oil discovery.

3.1.1 Libya before the oil discovery

Before the discovery of oil in 1959, and the commencement of production, life was very simple with very few big accidents. The Libyan economy had the same characteristics as any underdeveloped country, such as falling income levels, and low productivity in all economic resources required to begin the development process. It also did not have suitable funds to finance any significant development plans. Taking all these characteristics into account describing Libya as a developing country would be deemed to be an exaggeration (Minister of Economic and Planning, 2005).

The total population in Libya in 1954 was 1,088,873, (Minister of Economic and Planning, 2005). Agriculture was the major source of income for more than 70 percent of the population and contributed an estimate of not more than 26 percent of the gross national income. This was because of low capital formation and a lack of water resources. The manufacturing sector was very limited. There were a number of small companies in light industry, such as tobacco, olive oil refining, flour milling and canning tomatoes. The employment in this sector had been estimated to be 15 to 20 thousand in 1958, and the contribution to the gross national income was less than 10 percent.

The Libyan Economic and Planning reported that in 1952, 80 percent of the population of Libya was dependent on agriculture and animal husbandry. He added that agriculture itself faced extraordinary difficulties.

3.1.2 Libya after the oil discovery

As a result of the industry revolution after the discovery of oil and gas, the number of accidents has increased seven folds in comparison with the US, (NOC, 2009). Petroleum exploration activities began on a large scale at the beginning of 1952. The first major discovery of oil in commercial quantities was in 1959, precisely, by Esso Standard Libya Inc. (now Sirte Oil Company - SOC) and the port of Marsa El Brega where SOC's headquarters are based was officially opened in October, 1961 for the exportation of crude oil. The country became a member of OPEC in 1962, thus beginning an era of development characterized by a rapidly expanding economy. The following year the Ministry of Petroleum was established to take charge of the development of the oil industry at all levels. In April 1968, the Libyan General Petroleum Corporation was set up under the overall responsibility of the Ministry of Petroleum. It was empowered to engage in oil activities at every level, from exploration, drilling, and production to refining, exporting and marketing.

Thus ten years later, the annual personal incomes increased, the standard of living has improved and the economy has changed from a primitive agricultural economy to a petroleum one as a result of discovering, producing and exporting oil. NOC (2009). The oil and gas industry was no exception. Some oil companies were taken over by the state British Petroleum, American partner Nelson Bunker Hunt, Libyan American Oil Company, American Oil Overseas and the Royal Dutch Shell. Other oil companies signed partnership agreements with the Libyan state oil industry.

Currently, Libyan companies produce 85%. Although the oil production has dropped down from 3 million barrel to around half due to sanctions, international embargo, and lack of investment, nationalisation. The country is determined to enhance production. Although it had signed 40 to 50 production sharing agreements with International Oil Companies (IOC) before the 2011 Libya crisis to increase production from 1.3 mbpd to 1.6 mbpd or perhaps 2 mbpd with a target to reach 3 mbpd in 2015, the current production is barely less than 0.3. It is only in downstream and distribution and market where International oil companies (IOC) still play a major role.

3.1.3 Libyan oil and gas industrial processes

Libya has the largest oil reserves in Africa (39 billion bbl) and is the eighth-largest oil producer among the members of the Organisation of Petroleum Exporting Countries (OPEC). Libya after the crisis is back to normal production and wants to increase oil production to 3 million b/d by 2015, from 1.6 million b/d today 2013.

Since 1961, Libya has produced high quality, low-sulphur, sweet crude oil, primarily sold into the European market. The country is now the second-largest oil supplier to Europe. Libya's National oil Corporation (NOC) set up subsidiaries with offices in Europe:

- Umm Al-Jawaby oil Service Co. Ltd. in London, 1983.
- Mediterranean Oil Services GMBH in Düsseldorf, 1988.

The exploration areas in Libya are across the Murzuq, Sirte, Ghadames, Kufra, and Cyrenaica basins, as well as the offshore sector. Oil basins in Libya are shown in Figure 3.1.

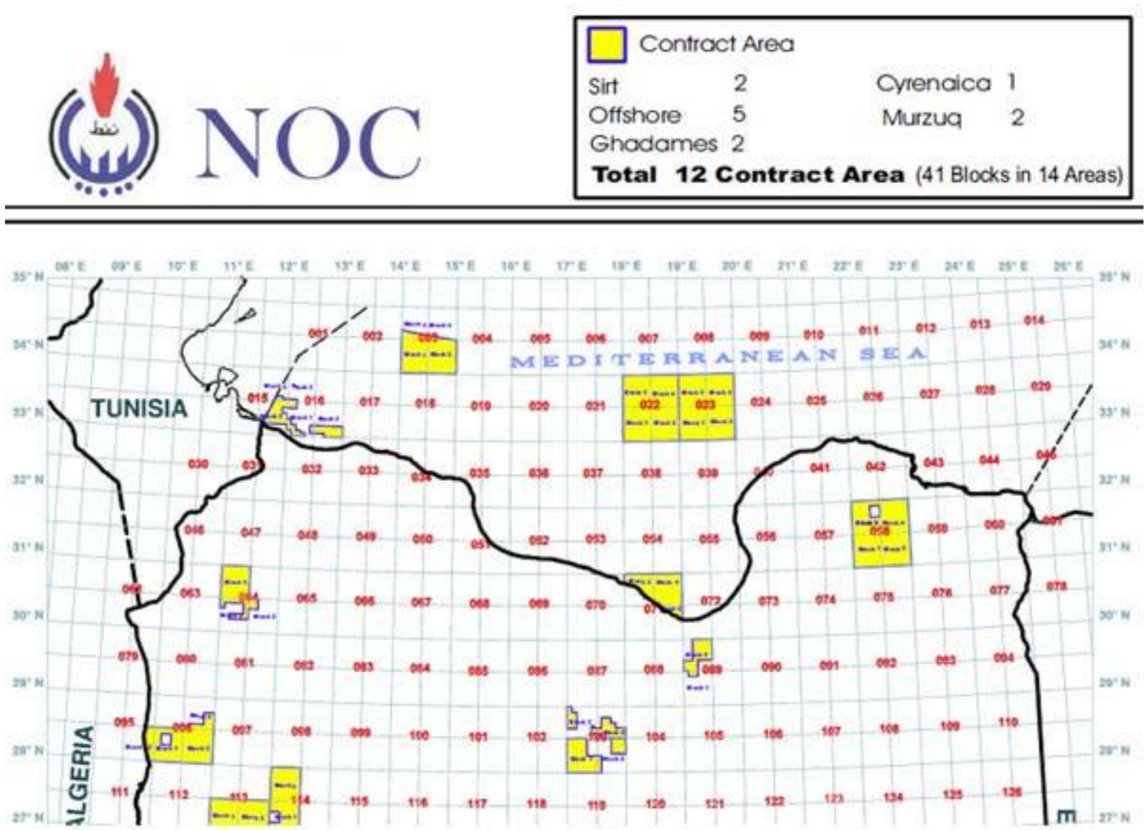


Figure 3.1: Oil and gas basins in Libya

The oil and gas industry throughout the world is one of the most hazardous industries. They include exploration and production upstream, refinery, and other petrochemical industrial branches in midstream and downstream, and all play a key role in Libya's industrial strategy.

This strategy derives from Libya's concern to diversify its economy away from the export of crude oil though the development of the wide range of industries capable of satisfying local demand.

Compared to the other industrial countries of the world, Libya is far behind. But since oil was discovered in 1959, it has become a developed, modern, vast and main industry in Libya. Now the oil Industry is contributing widely to the tune of 97% of national economy. Just before the discovery of oil and gas, 70% of the labour force was employed in subsistence agriculture and animal husbandry or agriculture related business (Libyan Ministry of Industrial, 2005).

Like elsewhere, in Libya too industrialisation has spawned its own health problems. Modern stressors include noise, air, water pollution, poor nutrition, dangerous machinery, impersonal work, isolation, poverty, homelessness, and substance abuse, insufficient safety and security in work. Health problems in oil and gas industries are as much caused by economic, social, political, and cultural factors as by pathogens. After all this petroleum's and oil and gas industry are causes of most environmental problems of the world now. This has become a major medical issue worldwide.

Oil and gas exploration and production activities carried out by NOC wholly owned companies and other international oil companies licensed by special participation and sharing agreements pose enormous HSE management problems because of their different country of origin HSE standards and experiences. Both the foreign and local companies HSE activities cover wide areas, both onshore and offshore, throughout the Country's territorial waters and continental shelf. Country geographical location makes as a gateway to EU makes Libya's oil products easily accessible to half a billion consumers, i.e. the European market. Moreover, Libya has a network of onshore oil, gas and product pipelines as well as completely equipped crude oil export facilities in addition to a gas pipeline connecting Libya to the European market through Italy; these established infrastructures provide greater transportation related HSE problems.

Due to long sanctions, Libya's upstream opportunities including most of the available onshore and offshore areas are still under-explored. With only 25% of the country's total area covered by exploration and production concession agreements, most of Libya's present, analysis indicates oil and natural gas reserves are about 77 billion barrels and 177 trillion cubic feet respective. Increasing HSE problems related to production and exports.

Libya's onshore oil has been found mainly in three geological trends of the Sirt Basin: the Western Fairway, which includes several large oil fields (Samah, Beida, Raguba, Dahra-Hofra, and Bahi) the north-centre of the country, which contains the giant Deffa-Waha and Nasser fields, as well as the large Hateiba gas field; and an easterly trend, which has large fields such as Sarir, Messla, Gialo, Bu Attifel, Intisar, Nafora-Augila, and Amal. Overall, Sirt contains approximately 80 per cent of Libya's proven oil reserves and accounts for 90 per cent of production.

New areas, which have recently been put forward by NOC, are largely situated within the Ghadames and Murzuq basins, such as Field A in Block NC- 186, Kufra in the south-eastern desert and Cyrenaica- Batnan. According to the latest information available, the Ghadames basin is linked geologically with oil and gas structures in Algeria and Tunisia. Murzuq has been a successful area for oil and gas exploration in recent years, with new fields including the El Sahara and NC-174 (Elephant) fields.

NOC is putting much emphasis on enhanced oil recovery to counter on-going depletion of existing reserves and this process will also improve overall new production and associated HSE problems. Since 2002, several new projects have been put in place by NOC and its international affiliates. According to EIA, Libya's challenge is to maintain production at its mature fields (Sarir, Messla, Nafora, Deffa, and Waha) while finding new oil and developing new discoveries with new HSE challenges.

3.1.3.1 Downstream activities

HSE problems are significant since NOC refines close to 380,000 barrels/day of crude in its refineries, located in different parts of the country operated by its subsidiary companies. Approximately 60% of the refined products are exported to international markets with Europe being the major market for NOC's products.

3.1.3.2 Petrochemical Industry in Libya

Libya has a total of eight petrochemical plants. Two polyethylene plants are situated at Ras Lanuf. There are plans for the development of a major petrochemical plant there. Abu-Kammash, al-Burayquh, Marse El-Brege, petrochemical plants at Abu Kammash, Ras lanuf Complex Phas 1 and Complex Phas II.

Marsa El-Brega facility produces 2200 tons/day Ammonia; 2750 tons/day Urea and 2000 tons/day Methanol. In the field of Libya's petrochemical industry, the Ras-Lanuf Refinery is the major player, utilising naphtha as a feedstock. Completed in 1984, NOC's refinerat Ras Lanuf, Libya produces 220,000 b/d of refined petroleum products per year. The refinery is part of a larger facility that includes an ethylene plant, a polyethylene plant, and Ras Lanuf Harbor.

Tow ethylene plants has an annual capacity of 1.2 M tons. It's main products are ethylene and propylene, Mix C4 and P Gasoline. Annual production from this plant is: Ethylene: 330,000 tons. Propylene 170,000 tons. C4: 130,000 tons. P. gasoline: 335,000 tons. Marsa Brega, close to Ras-Lanuf, has a gas liquefaction plant with as annual operational Capacity of 1565 Mmcf/day of natural gas. The National oil Corporation of Libya and Star Consortium consisting of Trans Asia Gas International and Star Petro Energy of the United Arab Emirates signed a Joint Venture Framework Agreement to establish a 50% - 50% Joint Venture Company for the revamp and upgrading of the Ras Lanuf 220,000 b/d Refinery.

3.1.3.3 Upstream activities

The exploration and production companies in oil and gas industry extracts from wells, performs some initial cleaning operations near the well heads, transmits treated the crude oil and natural gas product through pipelines where a large of operations are carried out to yield products in usable form either for fuel or for further chemical processing. Different engineering skills and requirements apply at each stage. The well heads are where the geology dictates, often remote with all the problems of providing infrastructure for staff. Besides the staffs that run such a group of well heads, there is also another group of engineers who drill the wells in both areas onshore and offshore.

Drilling, completion and production has become increasingly complicated over the decades as the industry has got better at recovering more oil and gas from each well, in the same time the HSE problems increased sharply. New processes have been introduced such as frocking and sour gas drilling. These teams are under pressure to maintain continuity of product and to increase production as much as possible, today the Libya production is 1.6 million barrel per day, and reduce the risk to workers and the environment. Naturally, there is a conflict with HSE matters. Somehow, safety needs to be a continual priority despite staff coming and going.

Whilst a big field might provide its own emergency services, possibly backed up by those of the local community, a remote site is very much on its own. Injured staff might need to be using helicopter to hospital; equipment might take hours or even days to arrive. Such problems are not unique to the situation in Libya. North Sea oil rigs have some very similar problems. Piper Alpha was an example of how things can go badly wrong in a remote location.

3.2 HSE Framework and Legislation in Libya

Unlike many other countries, HSE management in Libya is governed by many rules, regulation, legislations and laws in the form of resolutions related to occupational health safety and environmental protection aspects in general and oil and gas industry in particular.

3.2.1 HSE Legislation

HSE management aspects related to norms, rules regulations and laws include:

- Minister of Labour decision No (8) for the year 1971 to issue list of measures for the protection of the health of the workers and the implementation of the Article (102) of the Labour Law No. (58) for the year 1970.
- People's Committee's decision of the operational Industrial clause No.(205) for the year 1985 to issue a list of public safety and the prevention of industrial implementation of Article No.(14) of the code (93) for the year 1976.
- Resolution No (864) for the year 1977 on the activities of hazardous and extremely dangerous impacts.
- Resolution No (1062) for the year 1981 to issue a list of public hygiene measures.
- Decision of the General People's Committee No. (790) for the year 1980 on the use of water purification.
- The General People's Committee decision No. (105) for the year 1984 on the use of cylinders mounted on fire-fighting vehicles.
- Resolution of the Management Committee of the General Authority of Environment No. (96) For the year 2008 on the adoption of environmental requirements for the protection from the air pollution.

- The General People's Committee decision No (206) for the year 2009 on anti-smoking and tobacco use.
  - Labour law No 58/1970 and its amendments.
  - Law No. 93/1976 concerning industrial security and occupational safety.
  - Law number 13/1980 concerning social security.
  - Law number 2/1982 concerning ionic radiation and protection of its hazards.
  - Law 15/2003 concerning industrial process improvement and environmental protection.
  - Law 22/1989 concerning industrial organisation and its procedures.
  - Law 11/1971 for civil defence.
  - Law no 19/1987 concerning compensation to victims of industrial injuries.
  - Law no 2/1980 for economics of crime.
  - Law no 11/1984 for general road tariff.
  - Law number 2/1971 for mining of quarries.
  - Law no 8/1973 for preliminary prevention of oil pollution in seas.
  - Law no 106/1973 for issuing of health legislation.
  - Law no 3/1982 concerning organisational set up of water exploitation.
  - Law no 5 /1982 for forest and grazing protection.
  - Law no 2/1983 for archaeological and museums and documentation.
  - Law no 13/1984 for special conditions concerning general housekeeping.
  - Law no 15/1989 for trees and animal protection.
  - Law no 3/1424 for archaeological monuments and sites of historical importance in cities.
  - Law no 5/1990 for specifications and standardisation.

Based on best practice and significant developments in the field, the new HSE policy (principles and structure) has been recently introduced by Libyan NOC in 2007 to improve HSE performance.

This policy represents the highest level of commitment to HSE Management and applies to all Business Units and controlled Subsidiaries as the basis for them to develop their own HSE objectives, strategies, goals and programs.

The policy is being implemented gradually, by breaking down long-term goals (strategic goals and actions) into annual HSE objectives and strategies in the country and lower levels, to ensure that individual Unit efforts are in line with NOC principles.

The objective of the proposed system is to improve overall safe working conditions for everyone, and to reduce HSE risks arising from Libyan oil and gas technology, operations and products, to reasonably acceptable levels. The Libyan HSE framework is part of the NOC's framework. The objective of which is to establish an efficient data management process that permits effective decision-making, improvements in HSE cost control and communication, and achievement of successful HSE tasks fulfilment, in an integrated manner. In addition, the system underpins more accurate, open, and regular communications and reporting to external stakeholders, reflecting Libyan commitment to multi-stakeholder dialogue.

Under the umbrella of the NOC policy, Libyan oil and gas companies have initiated sub-policies such as the Waste Management Policy and the Road Safety Policy.

Within the framework of NOC regulatory system Libyan companies are required to introduce the new HSE Guideline "Health Safety and Environment Management System" to focus on the responsibilities and accountabilities of line management with regards to turning NOC HSE Policy and thematic policies (Road Safety Policy) into practice. The NOC Libyan Company Guideline is the basis for HSE management systems at all levels in companies operating in the country. Although HSE matters are interrelated and co-dependent, it is recognised that the skills and processes required to manage issues may vary according to the context.

The HSE guideline provides direction and conceptual guidance to managers to embed HSE into their business by describing a consistent HSE Management System (HSEM) of Company with clear segregation of duties. The Guideline describes the essential minimum elements (15 elements) of an HSE function, management system. It includes a requirement for system to be set up in such a way that it can be externally certified according to an international systems standard.

The HSE Management System contains only guideline-level requirements, which are broken down to specific processes and methodologies in order to ensure applicability at business level. Based on the 15 elements of the Guideline, companies identify 21 top-level Sustainable Development (SD) and HSE processes that are described in the so-called Global Operative Regulations (GOR), summarising the key processes, methods and division of responsibilities, which present case study Company-level expectations towards the individual member companies. The said 21 GOR descriptions include in addition to the classical HSE areas (e.g. waste management, fire protection, etc.) new regulatory areas like Product Stewardship, or Process Safety Management. This is also the first time when requirements for the three basic pillars of Sustainable Development are defined, providing new rules for the main corporate processes in order to secure compliance with the relevant SD criteria. The most critical action in (2009) by NOC Libya is the training of the referred 21 HSE regulations and put them into practice.

3.2.2 An overview of HSE in Libya

In addition to the NOC's role in monitoring and controlling HSE for oil sector, Libyan National Centre for Standardisation and Meteorology (LNCSM) was established pursuant to the Government Decree in 1979. LNCSM is a member of the International Organisation for Standardisation. LNCSM, being the sole standardisation body in the country, is entrusted with all activities relating to standards and measurements that include quality, performance, and safety. LNCSM is in the process to publish several standards in Industrial safety and health regulations, covering different subjects such as occupational health and environmental control, hazardous materials, personal protective equipment, and so on. In spite of the Libyan government's significant effort to support oil and non-oil and gas industry, the country suffers from certain significant problems associated with HSE risks, as outlined in the sections below.

Like elsewhere in Libya to, professional health safety and environment mean "Hard hats", safety boots, goggles, gloves and first aid equipment. Best practices and lessons learnt have shown a way forward for know how to arrange for and manage what is important for companies and for their unsafe practices leading to hazardous situations and dangerous works. Health safety and environment in the oil industries is widely believed as neither a commercial nor a practical essential motivation in oil business works. Consequently, overall performance is low in respect of health safety and environment in the industrial field in general and oil and gas industry in particular.

Current conventional procedures and prevailing practices in respect of professional health, environment and administrative safety within the oil industries are reported to have registered a lot of accidents and lost working hours.

Generally the basis for accidents statistics plays a major important role as primary performance indicators in the field of safety, health and environment. It records the occurrence of accidence or techniques indicating how to reduce casualties. It is widely found and reported that methods used in registering accidents statistics differ from one state and the other both in industrial and developing world. Generally it includes serious, fatal accidents, loss of time, accidents that cause loss of time and in some rare cases, lead to enormous loss of properties. Accidents as officially reported are the only ones that form the basis for statistics.

Increasingly health safety and environment at work site is becoming the overriding feature and the desired objective both in non-oil and oil based industries. Accident prevention is widely becoming a good commercial practice, which means safe operation is an effective operation. Accident prevention is thus the major goal for all the organised industries. Industries that cannot measure performance with precision are not be able to manage HSE. As rightly reported by (Bronstein, 1995), real safety performance is found in what we do and undertake. Similar is the situation in respect of people and their practice to achieve HSE.

In reality, a safety approach must start as a prevention process by performance or motivated by it. This alone can make it a reality to ensure that aim of incorporating specific roles and values becomes real. The saying that "Health and safety have their yield" is a rightly described to give results when it comes to putting this concept into practice. However, as reported by (Ahmad, 2000), there is very little success in the process. Some countries give a lot of excuses in this respect and feel "that is a waste of time" or "that is expensive". In reality the real problem lies in the fact that there are no meaningful, effective, defined and accepted explanatory guides on the manner to improve safety performance at site.

Conventional and traditional methods for measuring performance of health safety and environment management of any site involve inspection, work safety analyses and tests. Fact of the matter is that these statistics alone do not help an affecting safety efficiency at site. Nor do these figures reflect the efficiency level of the health safety and environment performance management at site. However, they usually indicate the misfortune or bad luck or good luck of site.

3.2.3 Discussion about HSE framework and legislation in Libya

The above explanations clearly reveal the response to the main question raised about whether or not reactive HSE methods are capable of improving performance. They raise the need to investigate what could be the best method in practice.

What industries need and require are a set of pre-conceived active methods which involve new tools, techniques and study of trends for reviewing and measuring HSE performance management at the site level instead of relying on reactive data (Quazi, 2001).

3.3 The Libyan National Oil Corporation

The Libyan National Oil Corporation (NOC) is responsible for HSE in all oil and gas industries. NOC has numerous associated companies shown in Figure 3.2.

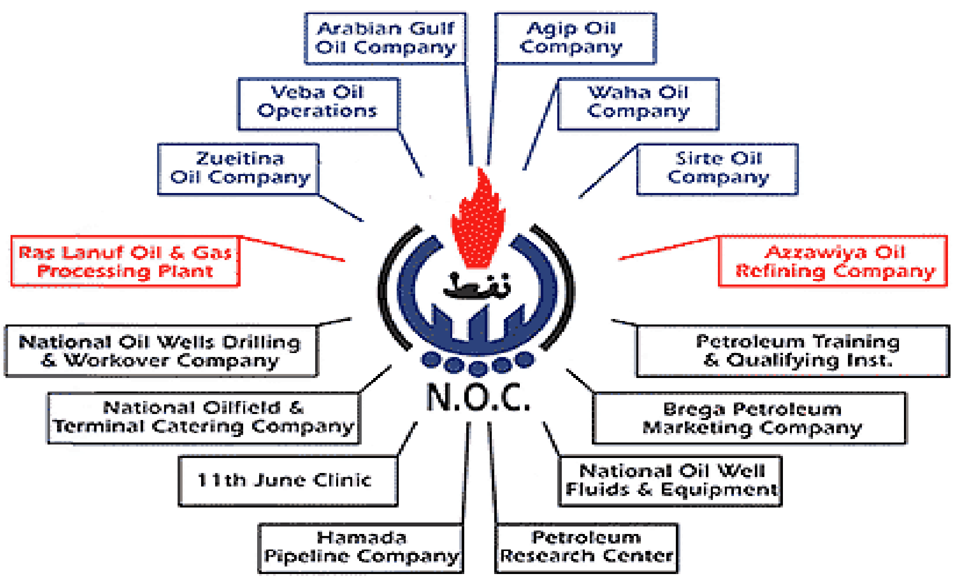


Figure 3.2: NOC and associated companies (Source: National Oil Corporation NOC, 2013 - Tripoli, Libya)

Libyan oil gas infrastructure is shown in Figure 3.3.

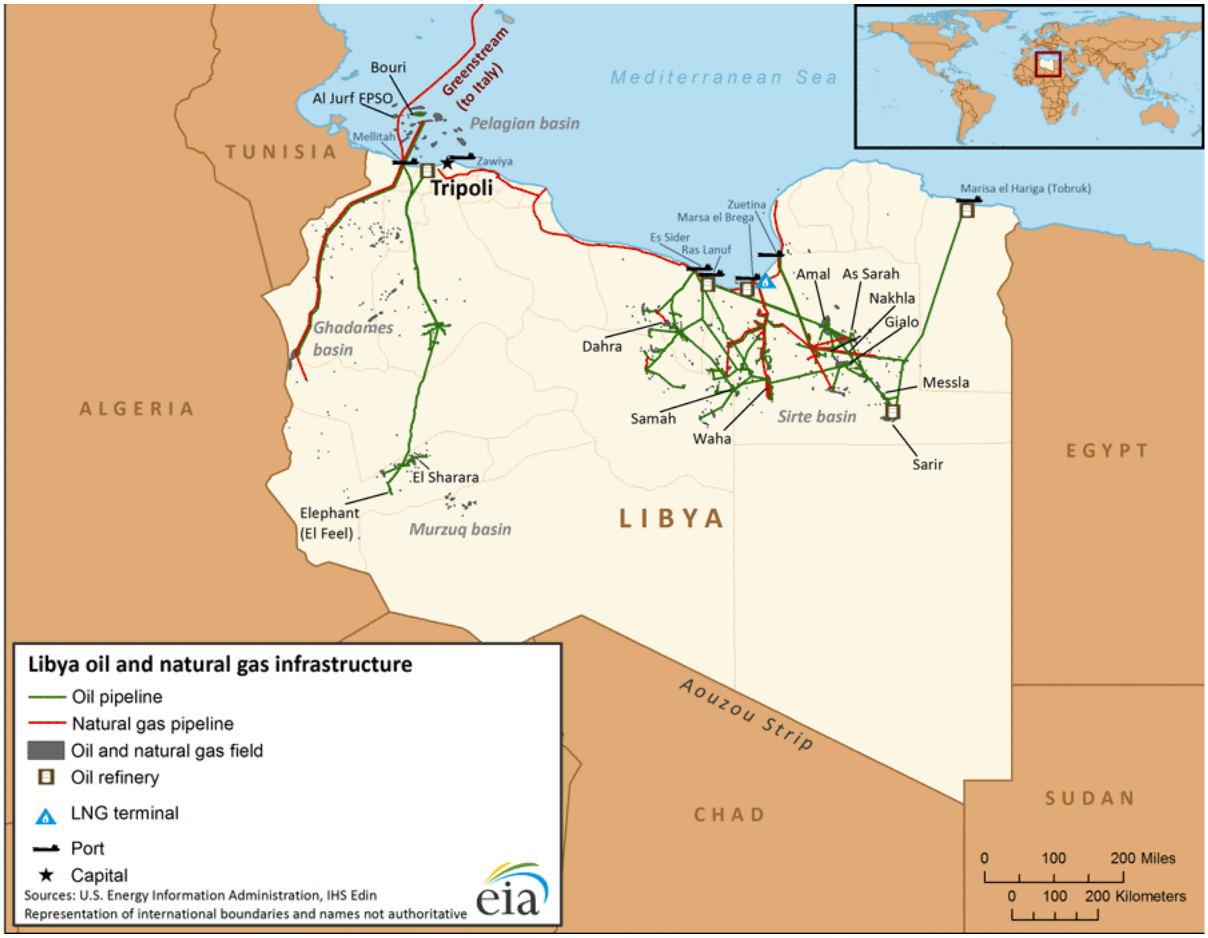


Figure 3.3: Libyan oil and gas infrastructure (Source: National Oil Corporation NOC, 2013 - Tripoli, Libya)

The key points about NOC are as follows:

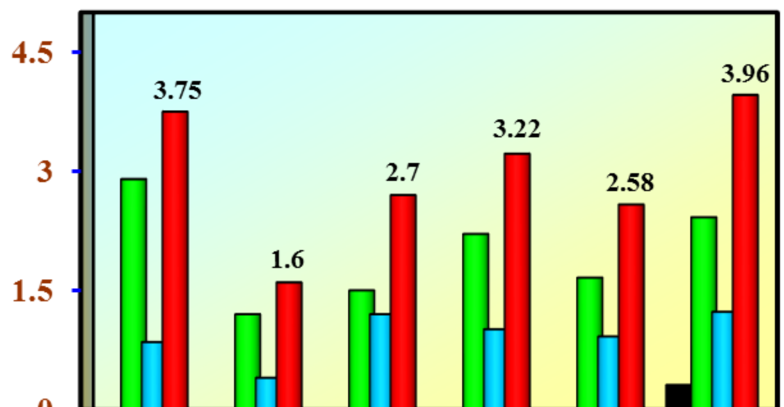
- NOC is the national oil corporation responsible for all of the Libyan oil companies (production, refineries, service and marketing).
- NOC has legal responsibility for HSE Management in Libyan oil sector.
- NOC conducts review visits and writes reports for all the oil companies.
- Imposes penalties in place.

Injury accidents reports from the NOC statistics given below in Table 3.1 shows increasing numbers of total injuries for the period 2003-2007 in Table 3.1.

Year	No. of injuries	Increased injuries from previous years
2003	16,970	2,500
2004	20,112	3,142
2005	24,650	4,530
2006	29,400	4,750
2007	35,117	5,717

Table 3.1: Total Employment Injuries 2003 – 2007 (Source: Libyan NOC General Report, 2009)

Table 3.1 shows in the last five years data on the number of accidents. It shows significant increase. The total numbers of injuries reached 35,117 in 2007 from 16,970 in 2003. More than 91% of these accidents are minor injuries. However, there is one recorded death for every 240 minor injuries in the oil sector in Libya shows in Figure 3.4. shows more details.



	2002	2003	2004	2005	2006	2007
FATAL ACCIDENT	0	0	0	0	0	0.31
LOST TIME ACCIDENT FREQ. RATE	2.9	1.2	1.5	2.21	1.66	2.42
NON-LOST TIME ACCIDENT FREQ. RATE	0.85	0.4	1.2	1.01	0.92	1.23
ALL ACCIDENT FREQ. RATE	3.75	1.6	2.7	3.22	2.58	3.96

Figure 3.4: Accidents statistics in period 2002 to 2007 (Source: Libyan NOC General Report, 2009)

3.4 Libyan Standards in Oil and Gas Industries

Like elsewhere in Libyan oil and gas sector too there are numerous standards by various multinationals like BP, Oxy, Chevron, Wintershall, Shell, Repsol, Ani, depending upon the country of their origin operating in Libya.

Libya has no QHSE standard of its own. NOC allows the operating companies to use and implement their country of origin standard. Many of the Libyan companies use old and not updated standards compared with US and European countries standards. There is an increasing recognition of the need for using one uniform standard to derive the benefits of an integrated quality health safety and environment (QHSE) management system. The present practice of loose or no uniform control gives the oil and gas industry difficulties in enforcing one standard. Thus the implementation of this non-uniform practice in Libya is putting the country in to a state of confusion in the oil and gas industry. However, with an economy that is the fast becoming one of the most developed in its area, the issue of achieving and delivering quality with general HSE has become increasingly important in Libyan oil and gas sector that is the life line for the country economy.

The Libyan government from 1971 onwards has issued numerous guidelines and regulations through National Oil Corporation (NOC) with the idea of formally introducing quality assurance and HSE in the oil and gas sector.

In the late of 1970s NOC started issuing a series of ad-hoc regulations and policies concerned with health safety and environment. The new regulations most of which are mere copy of some influential operating company practices had been written and distributed to all oil and gas companies to cover a lot of aspects of the oil and gas sector in health safety and environment in the workplace.

Attempts have been made to persuade operating international and domestic companies in Libya to follow the standards as regulations by law using ISO 18000 and ISO 14001 as the popular standards in oil and gas sector in Libya in general. But most of the western European companies have their own standard, which is approved from their countries to work in safe place and stay far away from the penalties, insurance and government court. However there are a lot of negotiations between the NOC and the working companies in Libyan oil and gas sector how to train on matters related to HSE for the Libyan employee in the real workplace. These types of training must be appropriate and include general awareness/familiarization training, function specific training, HSE training, etc.

Unlike many other countries Quality HSEMS in Libya too is intended to be governed by following laws in the form of resolutions related to safety, environmental protection and occupational health aspects in general and oil and gas industry in particular, with the type of production (crude oil, natural gas or white products) related to upstream downstream or midstream companies as outlined before in the same chapter.

However, policies and regulations on security, physical protection, liability, insurance, pre-notification and import/export/transit licensing alone cannot change human behaviour, an appropriate safety culture is required that ensures all the employees to do work safely, evolve to changing environments, and learn from past mistakes. Managers, and other employees are rarely if ever, in the position to jeopardize a systems safety directly. Their basic role is to organize employees in a way that enables them to cooperate in achieving the common goals of the company, and thus have a large indirect influence. A major problem is that company’s managers tend to have good technical background and are generally sceptical about human sciences. Management is responsible about 80% for health safety and environmental protection problems. This can result in accidents caused by human error being blamed on operators and technicians. This doesn’t divorce the general employees from responsibility for HSE, but highlights the need for qualified leadership from the top management.

3.5 HSE Performance in Libya

HSE performance in Libya is discussed in this section.

3.5.1 HSE key performance indicators in Libya

Libyan companies are required to use a mix of both leading and lagging indicators to measure overall HSE effectiveness and performance. Libyan company businesses do apply more specific leading or lagging indicator, which are used to measure HSE performances on both national and an international industry basis.

Leading indicators are designed to drive and measure critical HSE activities. When measured and monitored actively, the data from leading indicators enable effective intervention to address or reverse a negative trend before it results in injury, damage or loss. They comprise:

1. Reported near-misses, Unsafe Act and Conditions (numbers).
2. Incident Inquiry Rate (IIR).
3. HSE Behaviour Observations, Audits, Inspections versus planed (%).
4. Loss of Primary Containment (LOPC number).
5. Freshwater intake/consumption (m3).
6. Recycled, Reused and Recovered Materials (tons).
7. Road Accidents Rate (RAR).
8. HSE Audit findings closure rate (%).
9. HSE Training completion (%).
10. Emergency drills (number).
11. Lost Time Injury Frequency (LTIF).
12. Total Recordable Incident Rate (TRIR).
13. Total Reportable Occupational Illness Frequency.
14. Hazardous Waste (tons).
15. Controlled discharges to Water (tons).
16. Direct GHG emissions (CO2 eq. Tones).
17. HSE non-compliances (number).
18. HSE Fines/Penalties.
19. Environmental Provision release.
20. HSE Expenditure.

3.5.2 Libyan national oil corporation controls

Libyan control indicators specify the most important functional controls of over the HSE from the integrated operation point of view requires following controls such as reports, reviews and audits.

- Ad-hoc Incident Report.
- Weekly HSE Scorecard.
- Monthly HSE Projects Review.
- Quarterly HSE Management Letter.
- Six months HSE Performance Review
- Annual HSE Assurance Letter (Self-Assessment) and Audit Program.

3.5.3 HSE management deficiencies in Libya

The benefits of good HSE stipulation in oil and gas sector in Libya are not commonly appreciated. Inadequate risk management often only becomes obvious once it is too late. Some employers rely on a chance that accident will not happen to them. When it happens it will be time to estimate direct and indirect costs: insurance premiums increase, lawyers" fees, lost time, sick pay, investigation time, loss of business reputation, etc. Most managers feel that involvement of and looking after their employees will make them more committed, which will positively affect production, quality and internal culture. Making HSE objectives as important as other business targets shows dedication to work force wellbeing as well as raising image in industry and among customers, public and stakeholders.

In Libya there are a lot of workers from Africa, Arab, Asia and Europe that affects organisational performance, and HSE functioning as well. The following key points based on accident situation reveal that accidents events are sometimes increasing and other times decreasing. The overall trend is somewhat confusing. The summary of data show that the situation in Libya indicates:

- Significant increase and some- times decrease of accidents incidences over the last decade showing a general trend of increase in major occupational accidents to employees.

- Unstructured methodology because of numerous HSE procedures and practices by different oil companies operating in the country.
- Poor review experience because of inconsistent policies and procedures.
- Poor technology experience because of varying technology transfer practices.
- Lack of benchmarking because of non-availability of data and non-transparencies.
- Reports are not public because of lack of information.
- Poor training of enforcement agencies and lack of HR development programs.
- Lack of lessons learned because of ineffective feedback system.
- Lack of integration for best practice especially for the foreign oil companies due to ineffective and inconsistent control.
- At the same time in the world over there is al-together a different picture due to.
- Revised HSE Standards.
- Decrease of HSE accidents.
- Increased legislation.
- Tighter regulations.

However, audit methods are largely dependent on the experience of the auditors.

Therefore, there is a need to analyse the real gap to develop a structured and simplified quasi-probabilistic method for review.

3.5.4 Occupational HSE in Libya

The Libyan government through NOC plays an essential role in the oil and gas industries towards occupational HSE development. Two main objectives of main concern to NOC relate to:

- Establishing occupational HSE development in oil industries foundation with concept individual and joint venture partnership locally and internationally.
- Enforcing rules, law and regulations in order to process overall higher HSE performance for both individual employees and companies.

Libyan NOC is involved in providing these companies with all relevant system, institution and help for receiving supplies and material to attain, a consistent, coherent, stable and sustainable system in the country based on enhanced HSEM knowledge consciousness by adequately capturing it and sharing it as learning outcome described below.

3.5.5 HSE knowledge sharing in Libya

Davenport (1997) clearly reveal that knowledge sharing is a process that depends upon culture, employee behaviour, personal status, relations with others; priorities within top management, trust, fear of criticism, misuse of information, absence of criteria for evaluation knowledge, and motivator to sharing knowledge. These characteristics need to be studied to better understand relationships between organisation and culture to promote and support knowledge sharing. To get the best value of knowledge sharing process requires understanding style of the organisation. Value addition to get the benefit of knowledge sharing requires establishing a link sharing and everyday activities. As per (Jiang and Dang, 2004) the four vital factors that influence sharing knowledge at organisational level are knowledge itself, distance, sender, and receiver. As per (Andrews, 2007) sharing is like a learning ladder between individual and the learning community. It is based on the concept of hierarchy of knowledge, which considers sharing knowledge as a process starting from an individual through to group than to the organisation. (Algaehni, 2009) have similar views and have listed six factors that could influence the mode of sharing: (I) analytical learning, (II) structural learning, (III) experimental learning, (IV) synthetically learning, (V) institutional learning, and (VI) interactive learning. A hierarchal retrieval approach for knowledge (Miller, 1997) is based on individual to a group-based level and lastly to organisation. Of course, factors that differentiate company must include skills and facility.

Credibility helps decide acceptances and or rejections of knowledge sharing. Knowledge transfer occurs when credibility status reach good level of acceptances from recipient. Sharing process is dependent upon factors like size of the companies, differences in technology, numbers of employees and budgets etc. (Davenport, 1997) treats sharing as matter of communication between individual and organisation. As per (Jiang and Dang, 2004), three main hurdles to implement a knowledge sharing initiative are 1. Technology: and the tools used to support the process of sharing;.2. Process and the layout of the business unit and structure and 3. Culture as a perceptive of mindset of the companies.

Ackerman (2003) describe four aspects that can be outlined in knowledge sharing, namely (I) knowledge itself follows by credibility of sender, (II) context of the organisation, (III) collaborative status between the organisation and the knowledge broker, and (IV) mechanisms.

The value of knowledge by (Andrews and Delahaye, 2007) is influenced by sharing from two perspective, career prospects and individual reputations. Of late May (2005) (Hale et al., 2005) do consider the value of the knowledge and suggest need towards evaluating the importance of the knowledge. (Hale, 2005) depends upon factors like holding membership, good reputation and personal satisfaction. It helps move the people from hording knowledge to share knowledge for job-upgrading, involvement in issue making process, and social activities in the companies. (Gupta and Govindarajan, 2000) consider Knowledge as powers, which give level of importance and create, fear that makes holder feel to lose this power.

Hale (2000) defines a system called Reciprocity. Soft and hard Rewards for knowledge sharing needs a long time program to receive benefit. (Bartol and Srivastava, 2002) state short and long run strategy to get projects started. The four mechanisms for reward by them are.

1. Sharing—individual contribution to databases.
2. Formal interactions within and between teams.
3. Knowledge sharing across work units.
4. Knowledge sharing through informal interactions.

Cleveland (1995) treats knowledge sharing as a wide ranging process that includes document identification, storage and retrieval, tracking, version control, workflow management, and presentation. Document management technology as per (Cleveland, 1995) is just a part of the document management system to help organize knowledge for sharing knowledge. The top management support and commitment is important factors to help face the problem of hoarding knowledge. Top management support by

(Ackerman and Wulf, 2003) is important in order to remove the “us and them” attitude during the sharing process (Athanasius, 2000) found that face to face meetings should play major role in sharing performance. Three months to one year Job rotation as per (Bartol, et al., 2002) offers numerous benefits like:

1. Improved skills and experience.
2. Expanded professionalism.
3. Greater understanding of purpose, and skills for various departments.
4. Enhanced Professional relationship.
5. Assessment of skills, technique and related issue of sharing knowledge.

Dierkes, et al (2001) suggest that in order to avoid total project failure it is essential to build a corporate environment, for sharing and transferring knowledge to others. They rightly treat knowledge gap as a weakness in performance in a task. (Riege, 2005) suggest need for integration of the process of sharing and transferring knowledge with all activities to help successful implementation for knowledge sharing. (Dierkes, 2001) treat integration as networking, similar to communication proposed by Willem (2003) by relying on information technology. The integration towards knowledge sharing includes aspects related to annual program, budget, training session, top management, floor employee etc. Knowledge Cycle between different companies is reported to have a significant impact (Williams, 2001). (Hale, 2000) is equally applicable to HSE solutions to perform better sharing knowledge.

Dierkes, et al (2001) on knowledge management includes components like creation, transferring, and utilisation; that is vitally important to process the cycle of knowledge to perform the sharing concept between organisations. The knowledge cycle related to usability, usefulness, and sustainability helps organisation’s diverse needs as one of the motivators for sharing knowledge. (Marshall, 1999) suggest need to teach employees on the concept of sharing HSE knowledge including need to train them how to think beyond borders and search for a wider range of relevant solutions from other industries.

Analogy or case histories approaches need to be advocated. As per, (Marshall, 1999) HSE leaders may be encouraged to share and participate in.

1. Organizing workshops to learn more about decision making tools.
2. Better and effective listening.
3. Explaining the differences between private and public encouragement.
4. Organize knowledge by classifications system.
5. Idea and solution generation technique.

3.5.5.1 Knowledge sharing importance for occupational health safety and environment in Libya

There is an increased realisation to introduce HSE performance measurement and monitoring in both oil and non- oil based industry in Libya. With the realisation for change to knowledge economy the role of knowledge capturing, sharing and evaluation to achieve sustainable path many actors and players are engaged in process how to make the best use of information revolution to analyse pluses and minuses of the impacts of frequent changes of laws and regulations. Libya has signed three UN conventions on climate change biodiversity and land degradation. To meet these international obligations companies are exploring ways and means to reform and inventing their own solutions. Small and Medium enterprises (SME) with limited resources face insurmountable difficulty to accomplishing this job of meeting the international and national requirements.

This has led them to realize the need to learn from best practices on knowledge capturing and sharing to resolve and solve the problem. Undoubtedly large foreign based companies have low or no difficulty with resolving HSEM problem since they have access to knowhow, knowledge and expertise available all the time. However, SME face uphill task and feel that they need to re-invent the wheels (Hale, 2000). It is widely recognised that the problem regarding the lack of health and safety expertise among HSEM problems for most Libyan based domestic and international oil companies in general could be tackled and resolved by building a well-structured framework of knowledge knowhow and competence as practiced elsewhere. The lessons learnt from best practice solutions have lot to offer. In addition, during the last decade there has been a dramatic increase in literature and publications on sharing OHSE tools, techniques and technology related to knowhow, knowledge and best practices. Likewise to other countries, in Libya too knowledge sharing has also become an important issue from strategic perspectives. It is rightly seen and viewed as "the most strategically important resource which organisations possess” (Grant, 1996) and a principal source of value creation (Grant, 1996). Similar trend is seen in oriental countries as described by (Gupta and Govindarajan, 2000), who argue that sharing knowledge is a key task for an organisation’s success (Gupta and Govindarajan, 2000), while freezing knowledge could lead to lost opportunities for developing the organisation toward sustainability.

An Appraisal of knowhow, knowledge and competence gaps in Libya

It is widely believed that Industrialisation process seriously impacted by prolonged UN and western sanctions in Libya has made the country suffer from a number of major occupational health safety and environment related hazards. It is reported to as a health problem that seriously target community at all levels be it employee or general public and most widely our environment protection. This includes unsatisfactory state of HSE performance in terms of HSE indicators, lose or no controls and monitoring in the oil field, lack of prevention oriented and problem free programs and systems, lack of knowledge, knowhow, competence, expertise and technical assistance and lack of health safety and environment information, knowhow and knowledge.

The oil sector alone in Libya is unable to help build well-structured framework based on procedures, methods and widely varying multiple standards to control hazards and work practices. It needs to follow Exploration and production Forum, Guidelines for the Development and Application of Health, Safety and Environmental Management Systems. OGP Report Number 393, (2007) and OGP Guidelines for the management of Naturally Occurring Radioactive Material (NORM) in the oil and gas industry, OGP Report No. 412, Sept (2008). However, this conventional practice wherein the expert uses his knowledge with a good level of well documentation system and information is non-existent. This is mainly because of the fact that in the Libyan oil sector, most information available on knowledge knowhow and competence is lacking, this leads to preventable event and increased injuries. A quick scan of the scanty data provided by NOC, it is apparent, that the source of hazard if known could well explain the complex source of hazard and help prevents expected catastrophic results. This shows that better understanding of progression of vulnerability based on knowledge sharing is vital in lieu of the mere reliance on standards and regulations to control these types of hazards and progression of vulnerability leading to potential hazards.

A recent study for Libya by NOC Dec (2009) mainly focused on oil and gas industries related to light manufacturing, petrochemical, and E and P, Indicate status of non-oil industries in Libya which are based on supply by primary industries. It is found that Fabrication and light manufacturing are built to support primary and secondary. Libyan (NOC) is one of the largest organisations that run most of the public run oil and gas companies. The report highlights the need to modernize non-oil industries using Public private partnership run by highly advanced ethnology and joined with internationally well-known companies as partners. Is evident that all these Libyan public companies depend on each other for the supply and feeding of material such as natural gas, crude oil and so on.

The close look HSE problem for all the Libyan companies as per the (NOC, 2009) shows that there is trend that clearly shows increased incidence of hazard occurrence and injury. This shows the dire need for immediate action required to respond by tying these companies together. The (NOC) report highlighted the need for incident management and experiential learning to indicate that country needs not only control but to prevent Hazard and accidents that occurred with the same or similar scenario and the experience from neighbour to overcome this dilemma that is not activate yet. The NOC study further reveals the need for partnership based on cooperation between companies to overcome hazard posed by chemical substance that took place for many years. The report highlighted the need for the scientific approach to tackle a number of problems based on knowledge sharing and experiential learning.

Status of sharing and bridging the knowledge gap required for strategic risk control in Libya

The caring and sharing approach based on (Evans, 2005) charter and declaration is widely accepted as one of the proven technique. It is becoming popular as one of the established methods in more advanced and modern companies in western countries (Hale and Hale, 2005). It is evident that the best approach to overcome HSE problems posed at the industrial cities is sharing knowledge. However, in the current approach there is no clear focus on one single area. What is needed is overall information that should be over boundaries, which benefit all companies since many tools and techniques have level of similarity. Within the current UNDP country plan 2008-2011, the Libyan industries need to have increased number of new companies that include large and SME.

The current Libyan strategy on control of incidents related hazards is considered as general, with no specific guidelines and applications that apply a systematic approach which provide information for vital analysis and evaluation at all levels. What is required is increased application and guidelines such as:

- The use of zero emission or low-waste technology.
- The use of no or low hazardous substances.

The furthering promotion and support for (4R's) reduce, reuse, recover and recycle substances that are generated and used in the process of waste, where appropriate.

- Enhanced use of more comparable processes, that help facilitate techniques and methods of operation, which have been successfully applies, tried and tested with success on an industrial scale.
- More support for technological advances that help change in scientific knowledge, knowhow and understanding.
- The support of programs that lead to better understanding of nature effect, types and volume of the emissions concerned.
- The knowledge base right from commissioning of new or existing installations.
- The lead-time needed to introduce the best available tools, techniques and technologies.
- The data on nature, type and consumption of raw materials (including water) used in the industrial process and their energy efficiency including use of non-renewable.
- Need for prevention oriented solution to reduce and minimize to zero the overall impact of the emissions on the environment and the associated risks.
- Need for prevention oriented approach on incidents and accidents and to minimize or eliminate the adverse consequences for the environment.

- The need to evolve better solution that are most cost effective tools techniques and technologies in preventing, minimising or rendering harmless substance.
- Sound Justification for elimination of the technically infeasible options.

As per recent pilot study (NOC and L P I, 2009), need for partnership and practical steps for tackling hazard emissions among companies and hazard factors are similar. This is equally true even between different sectors and companies that have the similar or same problem since the materials used in these companies are the same. Additionally, need to establish relationship is one of the effective methods that could be effectively utilised among oil companies to exchange experience, knowhow, competence and knowledge to control hazard.

Critique on government rule on knowledge sharing

The Libyan NOC needs to take benefit from the lessons learnt and best practices to knowledge sharing. This action will help tackle and resolve numbers of prevailing problems that appear difficult to many companies for processing knowledge sharing. What is needed is the need to close the loop between supplying information and knowledge by shifting the concept of knowledge sharing from one - many to many-many concepts. This means potential for increased participation for companies that should involve in this chain of knowledge cycle. This is because of the fact that public sector alone cannot have the capability of supplying all type of knowledge and information. It is hoped that this step will make the concept of knowledge sharing as not an obligatory function but as compulsory of everybody instead of only government rule.

3.5.5.2 An Appraisal on enabler factors for knowledge sharing

The pilot survey carried out in Libya rate the support case study companies receive to practice HSEM with 6 points, on average (ten-point scale, SD: 3.16). The most important enablers for practicing HSEM are HSE literature databases, (online) occupational health literature database, online libraries, and full-text articles. The main barriers are lack of time, payment for access to full-text articles, language barrier (most texts are in English), lack of support and limited HSEM skills, and unreliable internet connectivity.

A critical appraisal of contributions made by various schools of thoughts involved in contributing knowledge sharing factors that enable organisations and companies clearly show that people lack vision of the concept of sharing knowledge. Various considerations regarding knowledge sharing namely technology, process, and culture, can provide a best framework. ICT do provide a silver lining in evolving appropriate tools to process the sharing of knowledge for HSE of oil sector in Libya. Management Professionals treat topic of sharing knowledge as a social dilemma. Some do ignore environmental issues and organisation structure. Cultural factors are least understood and need in-depth investigation. The way forward to evolve a future strategy must consider linking a group all factors that enable the sharing knowledge. Equally important is experiential learning from empirical research that needs to recognize all those factors that are critical in the field of HSE. In summary a host of influencing factors as independent variables need to be investigated to understand the dependent variable i.e. HSE knowledge sharing for complex situation of oil sector in Libya.

Knowledge sharing barriers for oil Sector in Libya

An overview of global factors that involve with knowledge sharing concept for its possible application in the oil sector of Libya is still in the initial stage. As well said by (Deanna et al., 2001) sharing knowledge performances are haphazard in most cases in general and Libya in particular. No wonder the differences in terminology and vocabulary have some influence in the sharing process between companies and organisations especially for people from different cultural backgrounds, representing various companies and organisation in the country. What is needed is a common language that could help ease the sharing process, (Finestone and Snyman, 2005) find that differences of language, lead to a different terminology that poses an obstacle for sharing and transferring knowledge. Methods such as face to face meetings could solve this problem. What is needed is streamlining the Bureaucracy of management at the organisation level to make free the unnecessary encumbrances (Cabrera, 2002).

A summary of survey responses in US and EU given in Table 3.2 shows the relationship for all factors as indicators involved in Knowledge sharing behaviour. Most indicators as variables depends on a number of factors such as culture, motivation, the knowledge infrastructure, relationship between sender and receiver, and type of tools to process sharing.

Survey of 100% indicators	50% oriented to people	25% oriented to process	25% oriented to systems
activities needed for knowledge sharing within organisations	Establishing new roles to leverage knowledge	Mapping sources of internal expertise	Implementing intranets and collaborative systems
	Enabling knowledge (training and education)	Creating networks of knowledge workers	Data warehousing
	Making knowledge visible to the organisation		Developing expert systems
			Refining organisational routines

Source (Ruggles, 1998)

Table 3.2: Survey of USA and European companies for sharing indicators

Study shows that Workers are not free to express their views. Their response to HSE problems are influenced by factors fear of criticism or the fear of losing their position (Simon et al.1999). Therefore, job security is important to successful knowledge sharing. The cultural differences play a vital role; Time workload and responsibility of others are two interrelated factors. The knowledge sharing process needs effort and time, and investment on this issue, otherwise whole exercise is futile and ultimately disappear (Husted, 2002).

Expertise in the companies could be an obstacle to sharing knowledge. The political will from top management has a role in resolving critical issues such as reputation and confidentiality (Menkhoff, 2006). Soderquist (2000) have focused on cultural aspects to tackle aspects like responsibility of others, see the factors and the description in Table 3.3.

Factors	Description
Confidentiality	OHS Occupational health and safety knowledge and solutions always involved with loss and damage which people would like to hide and not share with anyone
Lack of sharing process experience	From small and medium enterprise SME, mainly they are rarely involved with sharing process with others, resulting in lack of building and thinking of idea and concept to add some contribution.
Inventions protection	Result of hoarding knowledge, invention to develop a product are rarely shared but knowledge related control hazard should be shared for the purposed of protecting.
Specification and knowledge contexts	People are sharing specific knowledge while ignoring other knowledge that could have some possible relative use especially when expert use reasoning by analogy.
Specialist availability	When companies have specialist then most attention goes to internal source of knowledge instead of external.
Mode between parties	The influences of the mode of association between parties affect the sharing.
Organisation standards	People argue that organisation standards influence the sharing between different sectors and companies
Institutional memory	Institutional memory as Howard defined it is "the body of knowledge, formal as well as informal, that is essential to the continuous and effective functioning of the agency at all levels".

Critical mass	People point out that when solutions and knowledge reach overload due to unorganised knowledge.

Table 3.3: Barrier factors influencing Knowledge sharing (Source: Martinez and Edwards, 2004)

Critique on knowledge sharing barriers

The above exercise in the foregoing paragraphs have clearly shown that how identifying barrier influence knowledge sharing. Out of all the factors identified it is still not clear that whether and how and what level all these factors influence the sharing process in Libyan industries. This highlights the need to undertake an in-depth investigation for range of factors to accomplish knowledge sharing in the oil sector in Libya. There is no consideration about the weight age given to these factors in the literature, indicating that all factors have the same and equal weight.

The above literature search shows that there is the relationship between knowledge management and its goals and objectives with sharing knowledge. Most studies are unable to show this type of relationship, because of limited nature of data on management, technology, or people. This has prompted the author to further investigate sharing knowledge barriers from holistic perspectives bearing in mind the role of culture and philosophy to gain a better understanding.

3.5.5.3 Deficiencies in current initiatives on knowledge sharing

The increased numbers of initiatives shows the importance of knowledge sharing, however these initiatives for sharing OHS knowledge struggle to achieve its goals. The literature review was mainly focuses on knowledge that could help many organisations to control hazards in the industries. The idea of the data bank or database is explored the technology approaches that could make knowledge sharing more easy than using paper and pencil. However, databank could perform more accurately and faster with more "usability" by computer (Williams et al., 2001).

Recently, the COSHH Essential (The Control of Substances Hazardous to Health Regulations) for controlling chemical hazards in UK developed for SME. The two databanks are still limited for SME, which means that knowledge would not take the knowledge cycle between large companies and SME to exchange their experience. Ionising Radiations Incident Database is a data bank for solutions, which covers hazards posted by radiation with the cooperation of Health and Safety Executive (HSE). It contains 24 fields of record, which are useful for sharing knowledge on occupational health and safety (Croft, 2002).

The major hazard incident data service (MHIDAS, 2011) is a databank covering hazards that occur in mostly the UK and USA, and contains 11,000 incidents involving the transportation, storage and processing of hazardous materials. Fact NL (2014) is a database for accidents involving hazardous materials in Netherlands and contains 20,000 accidents with materials and processes involved in accidents, the user needs to purchase the databank.

Swaminathan (2000) have mentioned the Blaze accident database in India as a collection of accident histories, which used five classification systems. They categorised the accident and its solutions according to activity, causes, equipment, substance, consequences. The following points made which describe the main issues of the current project concern databanks for sharing knowledge:

- Keyword is mainly the driver of the process of sharing knowledge.
- Engineering and hygienist solution as starting point for most databank.
- Hazard and process represented by both engineering and hygienist, and third possible access could be preventive measures already in operation.
- No clear initiatives that show perfect in performance for sharing knowledge.
- No classification system provided at the majority of existing databanks.
- Some databanks resemble collection of accidents.
- Risk factors were not included in all databanks.
- Limited numbers of databanks cover processes.
- Numbers of prototype databanks in developing and testing stage.
- Home-grown solutions were not active in SME but intensive among large companies.
- Safety engineer, process engineer, hygienist designer are mainly the user and the provider.

- Unit operations have been use to classify solutions and knowledge.
- No systematic approach found in most cases to provide sharing knowledge.
- Experience is the only strategy for searching solutions.
- Experience and reasoning of analogy work are common tools for experts to deal with solutions.
- Current knowledge and related material consider to be bought.
- No guarantee of generalisation between companies.
- No creative thinking that could design the dialogue to ease and help the user sharing solutions and to find relative knowledge.
- No option of alternative control as strategy to navigate between knowledge and solutions.
- None of the current databanks could provide a method to generate ideas during sharing and navigating.
- None of the current systematic approach uses the concept of hierarchy of control during sharing knowledge.
- All databanks were built whether for specialist or for non-specialist.
- Value of knowledge in the current systematic approach considered too critical since there were no solutions or assessment criteria to evaluate these solutions.
- Isolation of existing databank was obvious which resulted in losing its audience.

The above factors conclude the previous reports, initiatives, and framework regarding databanks for sharing and dissemination of solutions, these issues need to take into considerations. The purpose of these databanks is to learn from the past and others by sharing the knowledge, especially in oil and gas industries. (Chung and Jefferson, 1998) state that it is clear that the companies do not learn from each other and from accidents that happened in the past.

Hale (1994) state that this system will help organisations to establish an appropriate framework by measuring where they are on the path to safety excellence. However, this should help the users to understand the gaps, and then stimulate solutions for hazard control and safe operation (Kelly, 1998). The authors have point out the most common methodology among current initiatives to process knowledge sharing in occupational health safety and environment as follow.

Classification systems

Classifying knowledge is essential for framework that provides sharing knowledge, however the consideration of classifying knowledge accounted as a requirement for any management strategy. Moreover, the classifications organize and allow knowledge for sharing according to the intended users otherwise the process of knowledge sharing could be difficult. The classification would provide a tree, which can describe a solution or a session in terms of branches/industries, hazards, processes, physical conditions and type of solution (Pantry, 2003). In OHS, mainly knowledge classified based on hazard and activities, which occupied into schema. (Hale, 1996) states that "the approach requires systematic classification and treatment of two aspects of the field, the type of hazard which arise and the processes and activities from which they arise". The classification system is dependent on numbers of factors include navigation point, user, method of navigation and methodology for searching strategy (Daoust, 2004).

Industrial hygiene approach

In the literature review, great numbers of approaches are presented, and each approach had its limitation in providing a sufficient and well-structured approach that could match the needs of all users. Absence of theory that could enable the user to share their knowledge accordingly was very clear from all initiatives. Only one single European project, (Solbase, 2003), was found to provide a systematic approach for sharing and controlling hazards in a very creative way from a hygienist perspective. However, most initiatives use a keyword concept, and non-experts stand hopelessly with an ocean of knowledge (Pantry, and Swuste, 2003). However, this provides solutions based on the hazard stage in three set of classes (at the source, path, and the worker). In other words, the result of this concept should show a description of the problem in terms of how the hazard arises and this description would follow Figure 3.5.

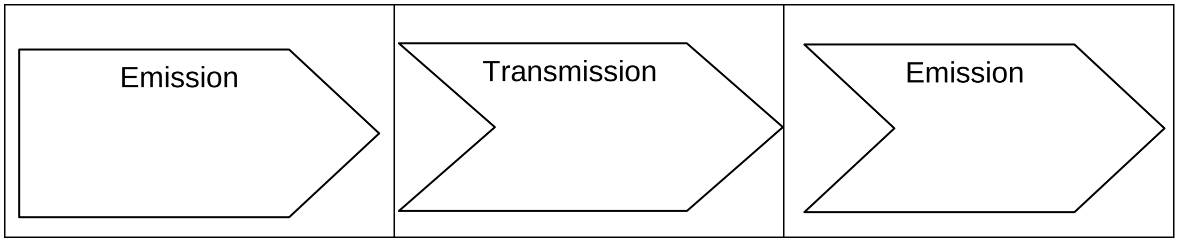


Figure 3.5: Hazard process (Hale, 1996)

Classification activities approach

Engineers share and search on knowledge-related activities or processes, such as safety engineers, operation engineers, process etc. Therefore, organising and classifying knowledge is vital important to be part of knowledge sharing process. The existing approaches to classifying the process by unit operation used for many years. For example, OSHA used the concept of unit operation to classify knowledge, but that was limited to construction industries (Else, 1998). The classification system for activities is not limited for sharing knowledge, but is also for other services by international patent organisations (World Intellectual Property Organisation, 1989). There have been many attempts to develop approaches to help SME but none have attempted to link together large and SME. However, SME face difficulties to control hazard when experience in specific field is lacking, however control hazard is complicated, and therefore an approach to simplify a controlled approach is required (Ann, and David, 1996).

The classifying knowledge and solutions according to unit operation is to lead the user to think of achieving the same or alternative function that influences the source (Hale et al. 1996). The proposed classification of the process or activity driven from design analysis, a descriptive analysis of the structure of a production process. According to (Eekels, 1987), (Hale and Zimmerman, 1994), the result should present the layout of the plant at three levels of knowledge, as follows. Firstly, Production function classification allow to search on a great numbers of individual process and sub-classes. A series of steps will appear in process after process because the classifications based on material flow with numbers of sub-classes.

These sub-classes are feeding; transporting, processing, waste disposal, and storage that have a common technique, and industry at this level having the same principles. For the purpose of the classifications system into three levels for knowledge sharing the following classes of activities are designed:

Processing operations

Operations include "all activities where materials change their form, state, composition, or assembly. It takes place at many scales from micrograms to tones, in unit, batch, and mass/bulk production. A broad classification of sub-function was made and this function results in major classification fewer than three headings; each heading contains different classes depending on the nature of industry. These three heading are:

- Shaping: changing of shape and or state with no volume change.
- Separating: changing of shape or composition with reduction in volume or division into several parts.
- Combining: uniting or coalescing into one body or one substance.

Supporting operation: Supporting operation and waste disposal is an operation, which contains elements of material handling and of processing and linked with following activities. Supporting operations consist of:

- Repair and maintenance.
- Replacement.
- Adjustment and setting.

Handling of materials: Handling of materials covers transport, storage and packaging, as well as the processes of feeding and emptying materials into, and removing products from, manufacturing processes which can be sub-divided as follows:

- Transport: continuous and discontinuous transport.
- Feeding/emptying: this covers the interface between transport and processing.
- Loading and unloading, storage and packaging: can be principally sub-divided according to the physical form of the product and the steps in the process.

Under each of these types of operations, alternative means of achieving the same result (or production function) are grouped together under the different alternatives, based on the associated hazards. The production principles, affect the choice of the energy source of the general process. It includes the operation and the distance to the source. It affects the selection of the motive power type and operational control method. It also helps determine the accident or exposure scenario. Finally it allows predication of the risk due to alternative strategies.

The production form is a description of the lowest level of process. It helps determine the details of the actual machine, its installation and the tools (Hale et al., 1996, 2003). (Sahami, 1997) states that expert's user mainly use keywords as an option for navigation. This method cannot provide the user with entire picture of the plant comparison with classifying activities according to design analysis. He developed an efficient method for inducing Bayesian classifiers which do not assume conditional independence of inputs (Sahami, 1996), since such independence assumption can be unrealistic for modelling words in text documents. The integration of the hierarchical clustering and classification methods will allow large amounts of information to be organized and presented to a user in a comprehensible way. The use of classification system according to deign analysis has been mentioned by many authors as helpful (Geankoplis, 1993). According to (Hale et al., 1996) benefit of classifying activities shows a number of possible solutions that user could see during searching. It is hard to articulate by other approaches. For example:

- Alternative design principles or materials for achieving the same function or alternatively with potentially less hazards or easily controlled hazards.
- Chance of changing existing production principle or form for safer one.
- Elimination of problem activities by modification of steps before or after.
- Show the possibility of improving the preventive measure.

Stimulation and idea generation

Stimulation and creativity thinking have never been introduced in the process of sharing knowledge until recently. Moreover, the idea of creative thinking has been integrated with risk management in order to perform safety excellence during knowledge sharing (Else, 1998).

In various Occupational Health and Safety (OHS) institutes, many attempts have been made to use creative thinking techniques in the safety field using control philosophies. (Culvenor, 1997) used the creativity thinking technique to improve problem-solving concept among engineers and students according to the hierarchy of control concept. Another example was outlined by (Leveson, 2004), using an analogy concept with stimulating thinking in solving problem. Moreover, the process in approaching the OHS problem by creative thinking perspective has been mentioned by a number of authors as a method in preventive conception (Hale, 1994; Else, 1997; Culvenor et al., 2002). The benefit of a non-expert in this case is very clear, as they could be of use for training and education purposes (Culvenor, 1997). The inspiration of stimulation creativity thinking in sharing OHS solutions has guided the relationship between existing elements of risk management (Hazard recognition, hazard assessment and hierarchy of control) as a process to controlling hazard (Culvenor, 2002).

However, it has better application for very specific and analytical questions. Intuitive techniques are less structured techniques (Miller, 1987). It tend to skip steps in a sequence and tend to provide a whole answer all at once, such as the “wishful thinking” technique (based on ideal possibilities and solutions), and it are more appropriate for undefined questions (Higgins, 1999).

Sometimes an uncreative culture could work as an obstacle to generate solutions or knowledge. (Shallcross, 1992) demonstrated in their studies that culture plays a part in creativity thinking between Chinese and Americans. Therefore, culture is important to take into account during implementing creativities thinking technique for searching and sharing knowledge. Absence of stimulation creativities thinking result of people use serendipity in searching, which is unreliable method for searching on solutions. It associated with difficulty of users to wait for solutions appear front of his eyes, in addition, as it leads to an endless process to reach a certainty of solutions. For example, people use keywords in sharing and searching for solutions usually use random words to stimulate new solutions or knowledge (De Bono, 1992). The chance of creating or finding solutions associated with the type of methodology is wasting time, especially with a high level of hazardous substance. This requires speed to solve the problem. Analogy is part of creative thinking that makes new things understood by comparing with existing ideas. However, expertise that use an analogy for a complex issue make it less difficult (Halpern, 1989).

Fundamental concepts for all brain storming creative techniques are:

- The suspension of premature judgment and the lack of filtering of ideas.
- Use the intermediate impossible.
- Create analogies and metaphors, through symbols, etc., by finding similarities between the situations, to be understood by another familiar situation.
- Build imaginative and ideal situations (invent the ideal vision).
- Find ways to make the ideal vision happen.
- Generate multiple solutions to a problem.

The principle in conducting these techniques involves the following steps:

- Gathering the participants from the field that is relevant to the study.
- Giving roadmap that brings many more creative ideas for the intended subject.
- Brief description of the problem.
- The session must be under the control of the leader.
- Encourage all participants to think.
- Write down all the solutions that come to mind.
- Evaluate the list to determine the best action to correct the problem.

In addition, according to (Osborn, 1948), the first rule is that the problem should be specific rather than general - it should be narrow down so that the barnstormers can shoot their ideas at a single target (Osborn, 1948). Osborn had summarised such a technique in twelve steps to get better results, as follows:

1. Understanding problems, by treating problems as opportunities.
2. Defining the problem, what is the real problem, asking Why?
3. Deferring judgment (brainstorming) and challenging habits.
4. Forming associations.
5. Evaluating ideas.

6. Putting ideas into action.
7. Observation and perception.
8. Applying the total process to practice problems.
9. Using checklists for idea finding (Osborn's tools).
10. Making unusual ideas useful.
11. Finding facts, problems, ideas, solutions and acceptance.
12. Applying total process to own problems with direction.

Broaden way of thinking

The mission is to make the user to think outside the box and find solutions from different sources. Absence of performing these tasks leads to reinventing the wheel. The hierarchy of controls in safety provides the users with structured guidelines. In this case, all results of searching by using stimulating and creative thinking poses minor risk in the strategy of finding solutions.

The generation of solutions in the field of OHS for oil and gas industry in Libya differs in designing systematic approach to generate solutions comparison with other fields. The systematic approach should mention processes, substances, working practices and working environments. These elements are the main determinants to produce hazards. Experts in the field of OHS use these considerations to identify hazards and to produce solutions. For example, changing the form of the substances with others as with hopefully less hazards is accounted as generating an idea. Other options to find the same form but with less concentration would help controlling hazards.

Hierarchy of control

The risk control actions need priority measures to control hazards at the workplaces. This priority of actions is called hierarchy of controls. The hierarchy of controls aims to reduce or eliminate the hazards, and dangers from high control order to lower order that results in effective prevention of hazards. The most well-known classification of prevention activities is mentioned and widely employed by (Higgins, 1999). The primary activities and strategies take actions in advanced stages, while secondary and tertiary ones take actions at different stages in the further development of the diseases or hazards. The primary activities and strategies related solutions seek for fundamental changes, the secondary ones seek to influence the sources of the hazards.

Table 3.4 below gives a clearer picture of the type of control measures.

Hazard process	**Hierarchy of control**	**Type of control measure**
Emission	At the source	Elimination
		Substitution
		Redesign
		Isolation
		Automation
Transmission	Along the path from the hazard to the worker	Barriers
		Absorption system
		Ventilation
Emission	At the level of the worker	Work procedures, supervision and training
		Administrative controls
		Personal protective equipment (PPE)

Table 3.4: Integration of hazard process, hierarchy of control, control measure
(Adapted from Hale A, 2003)

Knowledge division strategy

A strategic division for knowledge is vital but the associated issues such as users, type of knowledge and outcomes are fundamental to consider it. Dividing knowledge is simple task but linking the divisions with number of users is hard mission. It is important to group the types of users with their associated knowledge. It is intended for sharing knowledge with desired outcome.

The primary strategy

The primary strategy consists of preventive measures that influences the source activities and regulates the emission. This includes the elimination of source and the reduction of emission.

The second strategy

The second strategy covers the transmission of the contaminant with the control of the path of the exposure. Most solutions at this level cover ventilation and barrier of hazards.

The third strategy

The third strategy covers the emission and relates to personal protection. This type of solution is the easiest to implement and do not need high level of experience. The hierarchy of preventive measures have been mentioned in the literature for the past four decades and have the status of rule of thumb (Barnett and Brickman, 1986). The general requirement here is present in priority in selection and choice of solution, which need to follow the structure rule in adopting solution (Culvenor, 1997; Knowles, 2000). The priority in simple description should take high order solutions for the first section of knowledge.

Table 3.5 provides the relationship between hazard process and classification of preventive measure for each control strategy.

Relationship between hazard process and classification of preventive measures		
Control strategy	Preventive Measures	Process
Primary strategy	Source	Emission
Second strategy	Medium	Transmission
Third strategy	Receptor Exposure and Uptake	Immission

Table 3.5: Relationship between hazard process classification of preventive measures and control strategy (Adapted from Hale, 2003)

A lot of companies, institutes, and experts have given special attention to introducing solutions with a systematic approach (Hale and Zimmerman, 1994; Swuste, 2003). They have paid attention to these types of approaches since many countries have enforced legislation toward systematic implementation to control hazard. Therefore, the strategic approach that needs to simplify the classification system whereby the user should receive the knowledge according to hierarchy of control as follow.

- Elimination: is covering solutions that eliminate the substance or activities at the source.
- Substitution: is covering solutions that provide options in substituting form, or substitution of production of principle with others followed by;
- Automation: covers solutions providing an option in replacing manual handling to hazard material by automated which give the operator further distance from the source; also covers changing direct contact of hazard materials with possible remote control, then followed by;
- Isolation/enclosure/Barrier: is covering solutions providing enclosure to either operator or point of source.
- Administration and PPE: where the solutions cover the lower type of preventive measure, which are giving by simple classes of route of exposure or numbers of people also covering solutions concerning production form.

Buringh, et al. (1992) suggest that an action plan that implements these types of solutions should first analyse and study a number of elements to reach appropriate solutions. These elements focus mainly on the following list:

- Working environment consideration.
- Working practices.
- Working behaviour, and
- Worker characteristics.

Avoiding jumping to conclusions, by targeting ventilation or PPE negatively affects the order of the hierarchy of control made by most countries' regulations. Therefore the user or expert should go from low to high order of hierarchy as describe in the Figure 3.6.

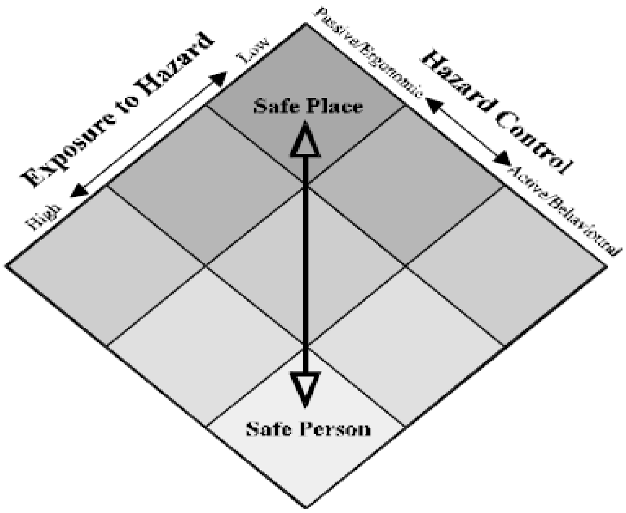


Figure 3.6: The low and high order of hierarchy of control (Culvenor, 2006)

Buringh, et al. (1992) explored the idea that companies lacking with solutions to reaching the top order when they face difficulties with sharing knowledge. In addition, two factors also involve in the lacking with implementing hierarchy of control is experts in the company, lack of attention of working condition at the developing stage (Swuste, 2003).

The time frame for implementation is also an important factor in deciding the risk control package. Care should be taken that 'short-term' measures do not become long-term. This is where we return to the hierarchy of control. Administrative controls and PPE can be implemented quickly to reduce the risk while the preferred controls further up the hierarchy are put in place. The administrative controls and PPE may then be unnecessary or may provide back up. Pam Pryor, Chrissie Stone and Dennis Else, Work Safe, Learning Guide UNIT BSBOHS404B Implementation of Strategies to Control OHS Risk.

Critique on approaches and mechanisms for knowledge sharing

Sharing knowledge mechanism required careful recognition of requirements to ease the function of transferability. In the literature, various articles and reports have contributed to developing a mechanism for sharing knowledge on HSE. Many suffer from a number of fatal problems. For example, giving more attention to activities or hazards without including factors consider vital such as (I) the users need, (II) searching strategy, and

(III) desired outcome in the framework. A holistic view prevents haphazard event in performing sharing knowledge mechanism. The advantage of technology makes the sharing process easier. Reliance on technology could isolate a great number of people (non-expert) and Small and Medium Enterprises (SMEs) where they have less expertise. However, this is true not only in technology but also in the field of HSE. This includes all those who use either keywords or classify knowledge according to unit of operation which makes knowledge in critical miss. This strategy helps all users and companies (SME and large companies) to reach appropriate solutions without any difficulty. There are suitable configurations of knowledge-sharing mechanisms for organizations with different characteristics as are found in Libya. The study by (Wai Fong Boh, 2007) provides a classification of knowledge-sharing mechanisms, and guidance to managers about the types of knowledge-sharing mechanisms that should be adopted based on the size, geographical dispersion and task nature of organizations.

Enabler factors for knowledge sharing

The following factors considered useful for developing excellent framework for sharing knowledge. Using reasoning by an analogy concept to solve problems has not yet been activating among many OHS professionals for knowledge sharing. However, (Hale, 2003) states that comparing one set of problems and solutions at any of the companies with another experience problem and solutions in the same industry is a powerful tool to controlling hazard. Many experts have no doubt regarding this conclusion, (Gunnigham et al., 2004).

However, this technique helps many companies to overcome problem occurred in the workplace and provide as success technique to transfer knowledge from one place to another. (Robson, 2002) states that people could learn from their experience and then applies it in new situations. (Algaehni, 2009) explored the fact that databases and reasoning by analogy have worked as a great tool to support learning in education and transferring knowledge to a new dimension.

Robson (2002) state that integrating a knowledge-based application system with other application should provide state of the art in sharing knowledge. Others argue that personal focus, language variety, and feedback capability affect the facilitator system for sharing (Ackerman et al., 2003). Databases and databanks have various components such as software, hardware and procedure (Accomazzi et al., 1995). Moreover, (Korvers, 2007) have list number of considerations, which contribute to understand and support sharing knowledge, as shown in Table 3.6.

Source	**Interaction feature**	**Considerations for choice**
Search engines	Anonymous	Quality control through linking process Cannot convey tacit knowledge
Professional website	Anonymous	Established practice Helpful for directed search Cannot convey tacit knowledge
List server	One-to many Asynchronous Not Anonymous	Prestige vs. Embarrassment Relevance of boundaries
Email	One to one Asynchronous Not Anonymous	Pre-existing relationship important Easy to evade Limited utility in conveying tacit knowledge
Print publication	Anonymous	Peer-reviewing high reliability Generally cannot convey issue around practice
Phone	One to one Asynchronous Not Anonymous	Pre-existing relationship important Easy to evade Good in conveying tacit knowledge
Face to face	One to one Asynchronous Not Anonymous	Pre-existing relationship important Difficult to evade Ideal in conveying tacit knowledge

Table 3.6: Supporting factors of sharing source. Source: (Williamson et al., 1996)

The reliability of databanks for sharing knowledge has been view differently by various authors. Expert and non-expert are two types of user concerned for sharing knowledge; these described from general perspective as databank users (Beaumont et al., 1991). The Classification system by (Accomazzi et al., 1995) as event tree scenario works for most experts as a good method of searching. (Ackerman and Wulf, 2003) state that 36% of expert used scenario-specific queries with no consideration for multiplicity user. However (Igor Burstyn, 2000) argued that focusing on one single factor would help to understand and solve the problem from different and various methods. However, project and initiatives that focused on one single risk factor have met with disagreement by others who suggest gathering all possible risk factors would allow user to take the problem from a holistic view. The possibility of developing standardised regulation is high if people consider all factors in the framework of knowledge sharing on OHS solutions (Burstyn, 2000). Stated that the possible contributing risk factor to human risk could fill the following categories (Source: Williams et al., 1994):

- Environment - factors occurring earlier in time resulting from the location of the accident.
- Equipment/Process - factors associated with the design of machinery, tools, personal protective equipment, or safety equipment.
- Supervision - factors relating to inadequate charge of workers.
- Training - factors relating to inadequate program of workers.
- Task error - factors relating to incorrect performance of duty.
- Medical - factors involving physical well-being at an earlier time.

USA has developed a databank for sharing solutions by OHSA. The data bank is restricted to construction industries, which make it critical for viewing risk associated with construction such as chemical substance (Beaumont, 1991; HSE, 2001). However, narrowing the vision on other possible risk and solution-related hazard from other industries would affect technique such as reasoning by analogy (Klaus-Dieter et al., 2006). However, a classification for risk is not hard to find. International institutes, governments, and private companies have common and well-known classifications for hazard. (Korvers et al., 2007) state that the knowledge application gap of current system due to approaching single risk factors on prevention programmed.

Critique on supportive factors for knowledge sharing

Knowledge sharing as per (Noorazah Md Noor and Juhana Salim, 2011) is the core of Knowledge Management in organizations. Employee Knowledge Sharing Capabilities of organization is an important issue in the Knowledge Sharing field. The ability as to share knowledge between organization units and departments contribute immensely to the performance of the organization. (Fan et al., 2007) noted that researches on Knowledge Sharing are developed from three aspects: (1) Analysing relationships between knowledge sharing and organization performance; (2) Discussing barriers, causes of formation and corresponding means about knowledge sharing; (3) Studying methods, tools and implementation technologies about knowledge sharing of organizations. These contributions are used in order to test it for formulating one single framework. Moreover, safety is a matter to all departments in the organisation, and with complex of technology the concept of sharing knowledge has become important. Safety expertise has mentioned that looking for past accidents is vital for preventing hazards re-occurring. This means that new experience on hazard control is out of the knowledge cycle due its restriction on old experiences.

Putting together these factors from various studies for empirical test could lead to identify the important from those unimportant in the oil industries. Process engineers and designers have taken this concept from a different angle, saying that reasoning by analogy inside and outside industries could help people to solve their problems and it is not necessary to limit the search on the same industries.

3.5.5.4 Knowledge assessment criteria and best practice

Dixon (2000) has defined knowledge assessment criteria as systematic examination of organisation knowledge, the examination of this knowledge for sharing could be implementing by answering the following questions:

- What knowledge already exists in the organisation that could be usefully leveraged?
- What do knowledge teams need in order to improve their performance?
- What knowledge sharing efforts already exist that could be built on?
- What knowledge provides the highest leverage for cost savings?

- Which teams are most ready to share and receive knowledge?
- What policies or practices in the organisation facilitate and constrain knowledge sharing?
- Who the stakeholders are and what are their interests?

Dierkes (2001) states it is useful to build a team of internal and external members to conduct a knowledge assessment. In the literature review, the criteria mostly focus on two aspects as best practice and good practice. However, these two aspects posted in the literature to describe the knowledge that work to control hazard. Knowledge in action is a lot easier to digest and a lot easier to implement but increasing number of companies has come to believe that the transfer of internal best practice is often fastest and most effective way to achieve improvements (Grayson, 1998).

The OGP Guidelines and European Agency for (Health and Safety at Work, 2000) could be the best source in covering the good practice. The OGP Guidelines and European Agency for Safety and Health at Work stating that good practice should provide persons who have a role in occupational safety and health with the knowledge to allow them to improve working conditions. However, there is no mention to best practice here and the above statement is covering good practice. Nevertheless, others argue that it is hard to find an exact definition to best practice because it is a broad term. Four factors play a major role in giving definition of best practice: (I) OHS systems and legislation, (II) culture, (III) language, and (IV) different experiences (Partidario et al., 1996; EASH, 2000). Further principle for knowledge by the agency (European Union) state that good practice should provide persons with occupational safety and health information. The information should allow them to reduce the health and safety risks to workers at enterprise level in the European Union.

The information should be of sufficient quality and quantity to produce, following an appropriate assessment of the hazards and risks present, a permanent and verifiable reduction in the whole potential to cause harm to all persons affected by the enterprise and ensure that the relevant occupational safety and health legislation met.

Overview of assessment criteria

The author took further review to identify the knowledge assessments criteria that are required to be transfer among oil companies from case histories and professional. The European Agency for Safety and Health at Work has extensive experience in this field, since they have access to most projects and accident associated with it. They looked at the subject from two angles, as "guidance" and "case histories". The OGP Guidelines and (European Agency for Safety and Health at Work, 2002) state that the application of knowledge that required controlling hazard should consider the following factors:

- Reduction of the whole potential to cause harm to workers.
- Improvement of working conditions.
- Demonstrate steps and methods that can be taken within a workplace or within an organisation to improve working living conditions or reduce health and safety risks at enterprise level.
- Focus on preventing the identified risk at source.
- Be current and relevant to intended users and existing work practices.
- Sufficient information should be included.
- The source should be a credible.

Source OGP Guidelines and (European Agency for Safety and Health at Work, 2002)

Critique on knowledge assessment criteria

Oil and gas, HSE, and OHS are the main source of knowledge in evaluating knowledge regarding hazard control, therefore it is vital to consider knowledge from holistic perspective, include Exploration and production (E and P) geology, reservoir engineering, hygiene, engineering, and management. Knowledge assessment criteria influenced by the differences of cultures, regulation, languages, standards that affect evaluate knowledge; however, these general factors cannot provide more detail on knowledge criteria that need to be share.

The criteria could be very clear when provider or knowledge receiver identified. General criteria could help, but detailing of these criteria required which provide users with appropriative knowledge for database sustainability. OGP Guidelines on oil and gas HSE, OHS professional, collection of case histories, recorded keeping process and procedure is a good source of criteria, but a survey among actual users is vitally important. Additionally, in-depth analytical approach based on case histories of successful solutions is excellent method to identify criteria, and a survey among expected users would help identify the priority among these criteria. In addition, congregate the factors from management, hygiene, and engineering in one investigation will provide level of balance.

3.5.6 An appreciation of the HSE challenges in Libya

Process plant in the oil and gas industry in Libya is generally designed in Europe or the USA. Whilst each design has an element of originality, the overall design is well proven and varies only in detail, being customised to meet special needs and the geographic and climatic settings. The HAZOPS analysis of the plant ensures that all malfunction possibilities are considered at a time when changes can be incorporated into the final design.

Some construction is built and tested in developed countries and transported to site. Erection, pipe work, tanks and wiring are done on site using personnel who are subject to the main contractor for the contract. The main contractor is responsible for the commissioning and usually plays some role in the training of the client's operating staff.

Process plant is highly automated and requires few operators. The plant has operated for months or even years between maintenance shutdowns.

The above scenario applies in Libya; the design, erection and commissioning of the new plant is to standards which vary little from those in Europe. The differences arise after a new plant is handed over to the client who now takes on the responsibility for operating and maintaining the plant.

Plant operators, though few in number, have considerable responsibility and need to be well-trained and thoroughly understand the plant they are controlling. If Libyan staff is used to operate a plant then they may have to be able to read and understand technical manuals written in English. There is almost certainly a cultural difference between the local staff and the designers of the plant in relation to Health Safety and Environment.

Plant maintenance covers a wide range but for the moment we can think in terms of infrequent planned maintenance when a plant is shut down and day to day maintenance carried out whilst the plant is still running. In the latter case, the work has to be carried out on a site where there is a possibility of inflammable material being ignited; the work needs to be planned and special procedures need to be followed. A full shutdown would involve removing all hydrocarbons from the plant and ensuring that any vessels to be entered have a safe atmosphere. Re-commissioning involves purging the plant with nitrogen so that hydrocarbons can be safely re-introduced.

Planned maintenance calls for a large workforce, well-trained and fully conversant with how to operate within the safe procedures called for.

3.6 The NOC HSE Management Framework

Based on best practice and significant developments in the field, the current HSE policy (principles and structure) is being introduced by Libyan NOC to improve HSE performance in oil and gas sector of the country.

This policy represents the highest Group-level commitment to HSE Management and applies to all NOC controlled Business Units and controlled Subsidiaries as the basis for them to develop their own HSE aims, objectives, strategies, goals and programs.

The policy is being implemented gradually, by breaking down long-term goals (strategic goals and actions) into annual HSE objectives and strategies in respect of both domestic and international oil companies based in Libya and lower levels, to ensure that individual Unit efforts are in line with NOC principles. This is being achieved by collecting and compiling data from newly designed daily reports and HSE forms (See Appendix B. C and D) designed and developed by the author.

The purpose is to improve overall safe working conditions for everyone, and to reduce HSE risks arising from Libyan oil and gas technology, operations and products, to reasonably acceptable levels. The framework is based on the Health, Safety and Environment (HSE) - Information Management System (IMS) (Triaster, 2014). The objective is to establish an efficient data management process that permits effective decision-making, improvements in HSE cost control and communication, and achievement of successful HSE tasks fulfilment, in an integrated manner. In addition, the system is designed to underpin more accurate, open, regular communications, reporting to external stakeholders, and reflecting Libyan commitment.

Under the umbrella of the NOC policy, both domestic and international oil companies based in Libya are required to initiate sub-policies such as the Waste Management Policy and the Road Safety Policy.

Within the framework of NOC regulatory system both domestic and international oil companies based in Libya have agreed to introduce the new HSE Guideline “Health Safety and Environment Management System” to focus on the responsibilities and accountabilities of line management with regards to turning NOC led HSE Policy and thematic policies (Road Safety Policy) into practice. The typical company Guideline is the basis for HSE management systems at all levels in companies. Although HSE matters are interrelated and co-dependent, it is recognised that the skills and processes required to manage issues may vary according to the context.

The HSE Management System contains only guideline-level requirements, which are broken down to specific processes and methodologies in order to ensure applicability at business level. Based on the 15 elements of the Guideline companies do identify 21 top-level Sustainable Development (SD) and HSE processes that are described in the so-called Global Operative Regulations (GOR), summarising the key processes, methods and division of responsibilities, which present both domestic and international oil companies based in Libya expectations towards the individual member companies. The said 21 GOR descriptions include in addition to the classical HSE areas (e.g. waste management, fire protection, etc.) new regulatory areas like Product Stewardship, or Process Safety Management. This is also the first time when requirements for the three basic pillars of Sustainable Development are defined, providing new rules for the main corporate processes in order to secure compliance with the relevant SD criteria. The most critical action in 2010 is the training of the referred 21 HSE regulations as given earlier in chapter2 and put them into practice.

For example, in respect of Road Safety Policy, a typical company with such a large number of different sites requires a lot of travelling of its employees, especially by car. To reduce the risks that employees face on the roads, both domestic and international oil companies based in Libyan companies have to arrange defensive driving training for employees whose work requires regular driving. All participants are required to take part in a theoretical course based on the Safe Drive Training syllabus, and then participate in a monthly distance-learning program to keep their newly-acquired knowledge fresh.

3.7 Research problems identified

In this flood of information on the problem, gaps and issue associated with sharing exploration and production Forum. Oil and gas industry recommended Practice (IRP) Volume 14 (2002), OGP. Health Performance Indicators: A Guide for the oil and gas sector. OGP Report Number 409, (May 2008). Occupational health and safety knowledge, the authors summarised the gap that led to inadequate knowledge sharing into four areas as follow:

3.7.1 Problem No.1: An increasing number of accidents in oil and gas industries

Definition

The number of accidents in oil and gas companies has increased sharply, as well as the number of serious injuries and fatalities. Accident data is difficult to find in Libya. However, an NOC report in 2007 revealed some accident data are shown in Table 3.7.

Year	No. of injuries	Increase from previous year
2003	16,970	2,500
2004	20,112	3,142
2005	24,650	4,530
2006	29,400	4,750
2007	35,117	5,717

Table 3.7: Number of injuries in the period 2003 – 2007

Table 3.7 shows five years' data and clearly indicates a significant increase from 16,970 in 2003 to 35,117 in 2007. This is not the sort of trend one would accept. It is really quite alarming and damaging to the image of oil and gas industry in Libya. Having said this, more than 90% of these accidents are minor injuries with one recorded death for every 240 minor injuries. The breakdown is 90% minority, 9.6 % serious and 0.4% fatal.

One has to ask "How good is this data?" Has practice changed so that more minor injuries and near misses are now being recorded? Was there a similar increase in the number of serious incidents? The workforce has doubled in size over this period? Just how big is the workforce? With one fatality for every 240 accidents, the number of fatalities must have been 146 in 2007, clearly a very high number by any standard.

In a similar way, Figure 3.7 below shows the number of vehicle accidents from 2002 to 2007 related to oil and gas industries. Vehicles are used widely to get around the various sites, and to travel between sites and the oil fields in the Libyan Desert.

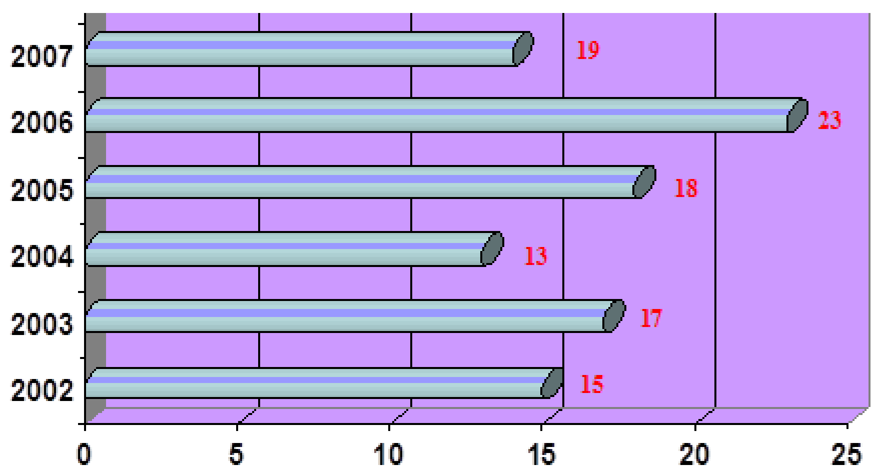


Figure 3.7: Vehicle accidents per year in the oil and gas industry

Accident frequency data from NOC is shown in Table 3.8 below.

Year	2002	2003	2004	2005	2006	2007
Fatal	0	0	0	0	0	0.31
Lost time	2.9	1.2	1.5	2.21	1.66	2.42
No lost time	0.85	0.4	1.2	1.01	0.92	1.23
Total	3.75	1.6	2.7	3.22	2.58	3.96

Table 3.8: Accident frequency over the years 2002 to 2007

The data shown in Table 3.8 suggest that whilst fatal and lost time accidents may be properly recorded, minor injuries and near misses are under-reported. Normal expectations would be for the number of minor incidents to be considerably greater than the number of serious ones.

In respect of the accidents per 1000 members of the workforce; it seems reasonable to hypothesize that the 0.31 rate for fatalities in 2007 relates to a single death but this is insignificant.

Discussion

There are many reasons for the unacceptably high number of HSE accidents in Libya and they include:

- Lack of awareness of good practices such as Awareness Preparedness of Emergencies at Local Level (APELL).
- Lack of simulations and table top exercises
- Lack of crisis response planning.
- Low or no HSE training.
- Significant deficiencies in HSE management.

Tackling these deficiencies requires a comprehensive, cooperative and continuous effort. It also requires commitment at all levels. Senior management must get involved and take interest to ensure that HSE policies, programmes, strategies and plans for action are implemented. Budget and trained manpower must be allocated in all operations related to Exploration and Production (E and P) in upstream, transportation in midstream and processing in downstream. Incident management of each and every incident and near misses must be property investigated and recorded.

Lessons must be learned and widely disseminated. These should show that effective management requires that managing major hazards must be based on measuring the performance of critical systems used to control risks to ensure they are operating as intended. This should form the basis of assessing and formulating regulation regimes.

Safety data in Libya must be based on models that help assess it as a measure of success in a holistic safety approach. It should not be based on whether an accident eventually occurred or not or how many times it occurred but on predefined measurement systems.

A walk through the history of safety regulation shows that legislation is usually the result of major incidents such as:

- The original safety legislation in 1862 where the failure of the pumping engine broke the only mineshaft and means of ventilation at Hartley Colliery in Northumberland. 204 miners suffocated and died as a result. This gave birth to mining legislation two years later that required every seam in a mine to have two shafts or outlets to the present.
- The goal getting (Safety Case) concept, which is as a result of the piper Alpha incident (pantry, 2003).

So in the real sense, legislation has always emerged on the basis of safety statistics. Measuring the performance of critical control systems requires understanding of safety process and systems. It should adopt a more proactive rather reactive approach.

In respect of legislation, the same has been true in Libya in that every single legislation or regulation has always been following a reactive approach then the premise upon which the safety concept has been built. This is the reason that why accidents continue to happen in Libya.

3.7.2 Problem No.2: Inadequate of a method for HSE performance review in the oil and gas industry

Definition

A study carried by the (Petroleum Research Centre, 2008), highlights that the insufficient system for collecting, storing and analysing of OHSE information and the results might be one of the major limitations for development of OHSE and protection of the workplace environment in every OPEC Arab country. It indicates the importance of developing and arranging the statistic records of OHSE accidents and occupational illnesses, as well as developing the procedures to monitor, evaluate and analyses result. The study also recommends the idea of self-monitoring through establishing and developing a specific OHSE department within the company, and encouraging the influence of quality management in improving the environmental workplace in the largest sector in Libya such as the oil and gas sector. The relation between NOC and EGA in establishing and implementing OHSE regulation has been lacking. All these activities are coordinated to avoid duplication and improve the services (Petroleum Research Centre, 2008). This report recommends the establishment of a framework to co-ordinate the planning and regulation of efforts in all in OHSE in all OPEC member Arab countries.

Discussion

Assessment and monitoring is an important step to ensure and facilitate better performance for any activity in oil and gas sector in Libya. Likewise, for the Occupational HSE, there are different performance assessment parameters, monitoring methods, procedures and the related management aspects. Some of these are of general type while others are more specific. Selection of the assessment parameters may serve to establish the required benchmarking or to ascertain a performance level leading to improved loss control management.

In an integrated upstream E and P oil and gas services company, where activities like exploration, well completion, production, maintenance, pipeline network and all associated services are available and undertaken in-house, the selection of the performance parameters and assessment system adopted, are required to be more elaborate and comprehensive. Each organisation has an HSE policy and set of defined objectives to be accomplished. This necessitates a better coordinated approach for the selection of performance parameters, assessment and monitoring methods with a view to ensure that the company objectives are met and sustained along with desired future trends.

While dealing with the subject and the concerned issues, a serious effort is required to emphasise a more system-centric system instead of a data-centric one. Good practice requires a practical approach that systematically covers to a large extent the whole gamut of issues involved including performance parameters, assessment and monitoring in the area of Occupational HSE management. The nature of the work must be based on; the field study, literature survey good practices, and the professional experience. The conclusions are that while finalising the performance parameters assessment, monitoring methods, procedures and the related management aspects, it is necessary to view it objectively, detailing the purpose and to ensure minimum acceptable HSE operating standards. Besides, standards of performance must be treated as an important tool ensuring Management by Objectives.

3.7.3 Problem No.3: Lack of technical and skilled manpower and poor maintenance management

Definition

Age and maintenance problems can increase the likelihood of accidents. This has been confirmed by events in Kuwait during the Gulf war (1991) and now during the Arab Spring in Libya. This led to stoppage of production and the resignation of the oil and gas Minister which resulted from a variety of serious problems. This disaster re-enforced the existence old HSE problems in the Arab Gulf (Simmons, 2002).

Discussion

The oil and gas sector in Libya generally suffers from a lack of technical and skilled manpower and an over-dependence on a foreign workforce, which is generally unskilled, low salary, temporarily employed, and often not trained in safe working practices. The events of (Arab spring) in Libya may well have had a similar effect.

However, data is not available to substantiate this. The lack of technical and skilled manpower is not only in upstream and midstream but also downstream in oil and gas companies in Libya.

The oil and gas industry in Libya is witnessing an unprecedented boom. Driven by a mix of rising international oil demand and geopolitical uncertainties about supplies, crude prices and refining margins that have surged in the past eight years, providing fortunes to government and oil companies alike. This liquidity and positive outlook on world oil demand have triggered a wave of new investments aimed at boosting oil production and producing higher value products that can also meet the more stringent environmental specifications.

NOC Libya like any other government agencies responsible for development and the industry is aiming at its specific needs to invest time and money in training local engineers, skilled manpower and other professionals. But this is far from an ideal world. Training engineers and professionals takes time. However, time is the one commodity that the Libyans do not have. So, the only immediate solution is to look overseas, to Europe, the US and Asia. But those regions are also facing an engineering and skilled workforce capacity crunch. Coupled with the still common misperception outside the region, that Libya like other countries in North Africa is not a good place to work in; it is difficult to attract the right calibre of foreign professionals to the country. The inevitable result is that employers in the region have had to pay inflated prices to attract the necessary human resources, driving up the cost of projects and further restricting the development of indigenous talent.

To learn from the past, the present crisis goes back to the oil price collapse in the early 1980s through the 1990s when the oil process industries experienced a tidal wave of re-engineering and downsizing in an effort to mitigate the tide of rising costs. Tens and possibly hundreds of thousands of engineers were laid off worldwide. Recruitment in the global oil and gas industry slowed and students, turned off by the bleak job outlook in the sector, opted for other disciplines. Training and development programmes targeted at the indigenous workforce suffered. All of this caught the Libyans unguarded against the current surge.

One of the most worrying aspects of the current skills shortage in Libya is the likelihood that the response to the problem will repeat the mistakes of the past, which led to the crisis in the first place. Libya has a serious long-term need to start depending on their own indigenous talents.

In the case study pilot companies, 30 senior western positions were lost through resignation. These were mostly engaged in critical jobs. It has become increasingly difficult to attract and retain expatriate design engineers, geo-scientists, production, drilling, and refinery process specialists. India, which was case study Company's most effective source of such recruits for professional jobs, is now in similar need for engineers and skilled manpower to meet its ambitious industry development needs.

A "Quick Hit" committee is introducing a number of measures to address difficulties facing attracting and retaining both Libyan and expatriate workforce in the face of rising expectations. However, the case study companies used have successfully completed a number of projects on its strategic investment programme. The Low Sulphur Diesel Production (LSDP) is one of the most complex projects undertaken and was successfully commissioned in 2009. The project used many innovative ways to alleviate risks through sharing manpower shortage problems with the E and P contractor by selecting a fitting contracting strategy.

The present shortage of skilled manpower for the oil and gas sector is felt equally by the International and National Oil Companies. They were all unprepared for the over US$100 per barrel of crude price which brought about this flurry of major investment projects requiring professional manpower. In the West, for almost two decades now, engineering colleges and universities have suffered from a lack of interest on the part of indigenous school leavers in joining these institutions. Many engineering departments faced closure due to this; they only survived by throwing open their doors to foreign students (mainly from the Asian sub-continent).

The present shortage of qualified manpower is not the result of any normal supply-demand internal adjustment between various branches of science and engineering. The cut in the supply side is far deeper and is the result of no new candidates entering for a long period of time. The demand, on the other hand, has increased tremendously over the past two years. In some cases the situation is rather comical when the client company, the contractor, and the technology licensor all try to lure away each other's staff working on the same project.

NOC in Libya like elsewhere in North Africa or the Middle East, the English language trained pool of expatriates is the only one that presents workable options. Even in the face of dwindling supplies, the western expatriate can provide good value for money. In addition to a tremendous rise in demand in their home countries, the demand for western expatriates has also grown from some new and unexpected regions: Russia, oil-rich former Russian states, China, Africa, and even India. This factor, along with some real and imaginary personal security concerns, has made it difficult for NOCs' Human Resources departments to attract the requisite number of western expatriates (who have the technical/ managerial skills to deliver value for money).

As far as pay packages are concerned, there have been many salary surveys conducted by professional institutions and several other non-government organisations from time to time; a well-qualified (PhD level) geologist with good working experience earns considerably more than what the NOCs are currently prepared to pay. The first thing that gets their attention is an attractive salary. Like it or not, Libya is seen as a less attractive place from the North American perspective. If they do not see a significant financial benefit to working in what they perceive, there will be little interest. We can assume that a 10 to 15 year experienced engineer in the oil and gas industry in North America will earn a yearly base salary of US$80,000 to US$100,000. From this perspective, why would they leave the relative safety and comfort of North America to move to the Libyan NOCs and earn less? On top of the base salary that they can earn in North America they would probably be looking at a premium of 30 to 40% to be an expatriate in this part of the world. Once you have their attention with an attractive salary offer, then the other items such as fringe benefits, living conditions and other social activities should also be stressed or considered.

The NOC in Libya must launch serious awareness campaigns aimed at the head-hunters and the potential western expatriates to highlight the fact that many places are fast becoming better options to live from the standpoint of a western life style (climate, housing, standard of living, amenities, entertainment, sports, schooling, domestic help and servants, low crime rate, etc.). Construction of luxury villas and plush apartment complexes is at its peak. These are aimed at not only the currently working high-income professionals, but also to lure rich expatriate retirees to make a home away from home in this part of the world.

India is the primary country that currently has a pool of English speaking technical and managerial professionals that is large enough to supply the immediate need of the Libyan NOC. It would take Poland and the Czech Republic at least 10 years to introduce English into their technical and engineering colleges to the extent that they would have surplus manpower in this category to meet the needs of NOC (currently the trend is migration to the UK). But this pool of technical and engineering manpower resources (like India) is also drying up rapidly. The oil and gas sector in India is giving serious consideration to the problem created for them by the sudden, en masse flight of their experienced personnel to pastures greener. In the recent past the eastern expatriates started moving within Middle East due to considerable difference in the pay packets. The NOC companies need to implement some kind of a “no poaching” code of conduct to prevent luring.

In summary, the pilot study shows that there are several reasons why it is difficult to attract and retain qualified and experienced western expatriates.

- Demand in home countries has increased tremendously.
- The IOCs have launched a recruitment blitz that has sucked up the supply pool.
- Demand by the non-oil sector has mushroomed.
- The perception about the security situation in NOC has worsened.
- Spouses have become more demanding; many of them are professionals in their own right and wish to pursue job careers. This facility is generally not catered for in NOC Libya.

3.7.4 Problem No.4: Lack of disaster prevention plans in the oil and gas industry

In addition to the problems related to OHSE, there are many previous reports, which have highlighted HSE issues. For example a group from LPI and NOC (2009) in Tripoli studies the disaster prevention system in the industrial cities in Libya.

For example, the city of Zawya has a big refinery close to the city centre. Obviously there is an increased risk for people living nearby. Re-homing many people and re-locating the refinery are both costly and long-term operations. However, things can be done to reduce the consequences of an accident. These would involve contingency plans involving the Fire Service, hospitals and transport. Planning could prevent further expansion of the site and the re-location of any particular hazardous process could be considered.

Another study (NOC and LPI, 2009) was carried out by the same group in December 2009 at four plants in the Marsa-Brega industrial area. It highlighted safety and environmental problems in the workplace, especially in medium-size plants. For example more than 65% of the employees are exposed to chemical agents, and most of the plants do not provide personal protective equipment. The study indicates the safety level is better in recently established plants than in older ones. In addition, the quality of fire protection is much better as a result of efficient supervision of the civil defence.

The study also found that no environmental monitoring was carried out in any plant, despite the fact that most of the plants or the refinery dispose of their toxic waste without any treatment and pumped it to Mediterranean Sea directly.

Field operations require risk assessment and development of practical security measurements to mitigate risks. This process requires identification of potential risks, establishment of boundaries, evaluation of consequences and generation of prevention and business recovery plans. Companywide standard procedures are often supplemented by project specific or site-specific instructions.

Libya requires packaged and customised solutions to protect every level of customer networks from intrusion, using data encryptions, and physical protection devices. This creates an environment of high assurance and secured architectures, featuring secured remote access connections, secured identity management and data protection.

Libyan customers need a robust and secured communications backbone that connects the exploration site with other company sites. This network must use fixed and portable communication units to enable secure voice and data exchange between groups or individuals. Other solutions must apply as well, such as Tracking Solutions, Air and Ground Surveillance, Over and Underwater Surveillance, and Identification and Access Control.

The engineering and development of reservoirs in Libya are major investments for operators, some costing billions of dollars to complete. Interruption of any kind is expensive. Onshore and offshore, there are tens of thousands of wellheads and installations with a range of security needs to be evaluated and implemented from a simple standalone land well to massive complex floating production and storage vessels. Even a simple standalone land well site's risk assessment must consider type of fluids produced, well pressure, directional configuration, measured depth and vertical depth, water access, location, enclosed status, sub surface safety valve, well maturity and reserves, damage containment, and possible collateral damage.

There is a growing trend towards the use of remote control centres. These require continuous monitoring, with the concept of the digital field wholly dependent on guaranteed secure communications.

Terrorist and federalist attacks on oil and gas pipelines have occurred in recent past in Libya. Pipelines and stoppage of work is the most popular terrorist target. The motives for such attacks vary considerably e.g. more jobs for unskilled unemployed young people. In some cases, the powerful explosive nature is seen to make any attack dramatic and more damaging. In others, energy companies are seen to embody the values of western society. The economic impact of a disabled main trunk pipeline is a serious concern to industry operators and nations.

Libyan oil transported by sea generally follows a fixed set of maritime routes. Along the way, tankers encounter several geographic “chokepoints”, or narrow channels, such as the Strait of Hormuz leading out of the Arabian Gulf and the Strait of Malacca linking the Indian Ocean (and oil coming from the Middle East) with the Pacific Ocean and major consuming markets in Asia. Other important maritime chokepoints include the Bab el-Mandab passage from the Arabian Sea to the Red Sea.

These chokepoints are critically important to world oil trade because so much oil passes through them, yet they are narrow and theoretically could be blocked at least temporarily. In addition, chokepoints are susceptible to pirate attacks and shipping accidents in their narrow channels.

The potential of Libyan oil and gas industry is also high for tanker trucks, loaded with flammable liquids to be intercepted while in route to service stations, power stations or petrochemical plants in order to cause collateral damage and disruption to the supply chain. Tankers can also be hijacked and used as a weapon against other targets. The release of hydrocarbons and the resulting fire and explosion could have a devastating environmental impact, especially if any material is released into Libyan coast line which is more than 1900 Km. The consequences would be immense in densely populated zones in Tripoli, Benghazi, Misurata, Sirt, etc. At the petrol service stations, theft in the form of customers leaving without paying and credit card fraud are common threats, while protest groups regard these stations as easy targets.

3.7.5 Discussion of problems identified

The data presented above are not highly reliable, but it is the only data available. The instability of 2011 and the fall of Gaddafi have made the political system very difficult. More recent or better data for the years up to 2010 cannot be obtained.

Whilst the data available is not reliable, it can be said with a fair degree of certainty that accident rates are very far from the values expected in other countries where HSE is taken very seriously.

The successful growth and development of the oil and gas sector in Libya, a dramatic increase in general accidents as documented in NOC reports may have a significant impact on the development in the future. The previous studies also highlighted other problems, which occur especially in hazardous areas. Health and safety may coincide with environmental problems in having the same limitations that could be summarised as below:

- Insufficient and not reliable system for collecting, storing, exchanging and analysing HSE information.
- The above information may well be under-reporting minor injuries and near misses; action on these may well reduce more serious incidents.
- Lack of an involvement and co-ordination among the many different departments and individuals.
- Inspectors need to be well-trained and have the authority to stop any unsafe operation.
- Lack of incident investigation and analysis.

3.8 Summary

This chapter outlines the specific details of the HSE problems in oil and gas sector of Libya to meet the challenges of change required to in the present day knowledge based economy. Existing HSE Management is reviewed and evaluated. The previous chapter showed that many Libyan oil and gas companies handle HSE management in a very bureaucratic way. This provides more justification for developing a new HSE performance review methodology which would be effective, easy and inexpensive to run, as well as legally accepted.

Chapter 4: RESEARCH METHODOLOGY

This chapter is designed to present an outline of the HSEMS framework design and research methodology used in this investigation to evolve a HSE performance review system for oil and gas sector in Libya. It gives an outline of the methods used in this research and describes the procedures used to collect the data. It also explains the theory underlying the methods to help understand the reasons for undertaking certain activities.

The chapter describes the procedures used to prepare a knowledge base and standards designed for Libya. It also describes various viewpoints, concepts, approaches and theories underlying the methods and standards developed to explain the logic utilised for undertaking this research. Based on concepts of research question introduced in chapter 1, and guided by the review of the literature in chapters 2 the present chapter describes the methodology evolved to resolve the problems outlined in research.

This chapter is presented into two main sections. The first one focuses on the learning derived from in-depth literature search on internet, research papers, earlier research thesis and published literature on research methodology, standards developed and design. It includes the type and nature of specific research, approach and design, and finally, the differences of quantitative and qualitative research approaches. The second part deals with the processes evolved and implemented in the design and execution of this research in order to obtain results to achieve the research objectives.

4.1 Research methodology

The empirical research carried out in this thesis is done with the cooperation both from NOC and several domestic and international oil companies using interviews published reports, and surveys. Data is analysed both quantitatively and qualitatively. The objective is to find statistical prevalence of HSE critical factors in the context of Libya.

The purpose of this research methodology is to discover answers to questions through application of more rational and relevant scientific procedures, to realize and fulfil the specific purpose bearing in mind that any research usually depends on what is being investigated. Broadly, research objectives for this investigation in question can be categorised into the followings (Aaker et al., 1998).

- To interrogate and find out things i.e. to find a solution to a given dilemma or problem
- To make prediction of events, e.g. market survey or opinion polls.
- To recognize and understand social problems or phenomena.
- To transform and change the world by influencing people's way of thinking by providing alternative solutions to investigated problems.
- To expand body of exiting knowledge on a particular topic by disseminating widely the knowledge gained.

The aim of this current HSEM is to introduce a performance review methodology for both domestic and international oil companies based in Libya and to discover answers to questions through application of scientific procedures.

4.2 An overview of empirical research methods

A research method as described by (Svenson, 2001) is a systematic plan for conducting research. Also as stated by (Viscusi, 2006), it is the unique way in which research needs to be conducted to evolve the process to be carried out under the research. These can be either qualitative or quantitative or both that the researchers need to adopt and carry out their research in different ways. However, (Sekaran, 2002) defines research as "an organised, systemic, database, critical, scientific inquiry or investigation into a specific problem, undertaken with the objective of finding answers or solutions to it".

In a nutshell, a research methodology in line with views of (Al-Qahtani, 2007), refers to a systematic process comprised of identifying, defining or enunciating a problem, formulating a hypothesis, collecting facts or data, analysing them, developing standards and deriving conclusions either as solutions to formulated problems or as generalised theoretical formulations.

On the other hand, the world of social science provides numerous classifications and definitions of research methods. For example, as per (Colin, 2002), a research method is described as the initial phase of choosing a research strategy to identify the purpose of the research that could be exploratory, descriptive, or explanatory. Thus after choosing and deciding a purpose one should be able to develop a research strategy.

An overview of a method research shows that it is to present a systematic plan for conducting research. As per (Sotirios, 2005), the way in which report is to be conducted is determined by the methodology under the report. So, qualitative and quantitative reporters are required to conduct their report in different ways. Moreover, according to (Sekaran, 2002), report can be defined as "an organised, systemic, data-based, critical, scientific inquiry or investigation into a specific problem, undertaken with the objective of finding answers or solutions to it".

Indeed, a report refers to a systematic method consisting of enunciating a problem, formulating a hypothesis, collecting facts or data, analysing them, and forming conclusions either as solutions to formulated problems or as generalised theoretical formulations.

The world of social science has also provided many classifications and definitions of report method. (Colin, 2002) describes the initial phase of choosing a report strategy as being able to identify the purpose of the report, which can be classified in one of three ways: exploratory, descriptive, or explanatory. Deciding a purpose should enable the reporter to develop a report strategy.

Colin (2002) shows that when setting out to explore a research question the researcher needs to first decide the purpose of the work, be it exploratory, or descriptive or explanatory as outlined below.

4.2.1 Exploratory research

This type of exploratory research is designed with the aim to find out what is happening with a view to seek new insight, and asks questions of new, challenging and emerging subjects. This type of research is generally concerned with new subject areas. There is seldom the opportunity to collect quantitative data. As per (Hussey and Hussey, 2003), this research type is open, and uses flexible data collection methods like the case study technique, personal observation, and historical analysis of secondary material for collection of a wide range of data.

4.2.2 Descriptive research

This type of research has the unique purpose for providing and describing a shape of an established state. It requires compiling substantial knowledge and developing an in-depth understanding of that state. This type of prior knowledge and understanding allows the researcher to choose on all aspects of the subject area that needs to be probed to seek further information. Such a type of research can be either a qualitative or quantitative or both in natures. As per (Hussey and Hussey, 2003), and by (Al-Qahtani, 2007), this methodology mainly describes phenomena as they exist, and probes the problem further than an exploratory study.

4.2.3 Explanatory research

In this type of research methodology, the study is designed to help evolve an established state with full satisfactory explanation. This state helps resolve an identified and defined problem by gathering the data (qualitative or quantitative) to explain the reason and logic behind this problem. The research approach helps to determine the causal relationship in the host of variables identified for better understanding the phenomenon or problem studied (Hussey and Hussey, 2003 and Al-Qahtani, 2007).

4.3 A critical overview of HSE research approaches

Research in HSE can be broadly divided into two approaches i.e. qualitative and quantitative. Social scientists have widely varying views about the distinction between qualitative and quantitative research approaches. The overview shows that there is the need to keep the two types separate. However, (Colin, 2002) and (Al-Qahtani, 2007) have attempted to bring the two together. Keeping in mind this longstanding debate, it is possible to evolve and find consensus about clear definitions of the two.

4.3.1 Qualitative approach

The qualitative approach is generally employed to gain an insight into the intangible aspects of complex social and organisational areas of study. It looks in to all related aspects to develop an in depth understanding of the entire relevant topic. It interrogates the system and tends to answer questions such as "What?", "Why?" or "How?”. This means that all required data are gathered in the form of words rather than numbers. Thus the qualitative approach is a way forward to help hermeneutic researchers to find the most appropriate and deeper understanding of a special research problem (Al-Qahtani, 2007).

As per (Hussey and Hussey, 2003), the qualitative approach is deeply rooted in the phenomenological paradigm that involves some kind of interaction between the researcher and the people or the situation being researched. In other words the qualitative methodology as per (Idris, 2000) emphasizes and helps unfold social processes, primarily through the exploration of the research participants.

Another interesting researcher (Hakim, 2000), indicates that the great strength of qualitative research lies in the fact that it helps determine the validity of the data collected. Data are normally gathered in sufficient detail for the results to be taken as true, correct, complete and believable reports of participants’ views and experiences.

However, the main demerits and drawback of this approach is the way one decides the problem of the sample size. This as per Hakim is because of the fact that qualitative projects normally have small numbers of participants. Such numbers cannot really be taken as representative (Hakim, 2000). This operates even if great care is taken to choose a fair cross-section of the type of people who are the subjects of the research.

Keeping above in mind it is evident that Qualitative research methodology may be used as a first step in the design of structured interview surveys (Hakim, 2000) and (Al-Qahtani, 2007). This type of research also has the benefit of being associated more with qualitative analysis and discussion that allows non specialists to understanding the outcome more easily. Methods of qualitative design generally include case studies, either single case or multiple -case designs, which provide descriptive data of the subject under study. Meta-analysis is generally employed and designed to use statistical results from previous research; research analysis of administrative records, which has the feature of access to knowledge not normally found elsewhere. In this type of methodology the focus group discussion allows the researcher to bring together a number of informants who serve the issue of investigation. It employs in-depth interviews in the form of structured or unstructured questioning design (Silverman, 2000 and Al-Qahtani, 2007).

4.3.2 Quantitative approach

As per (Remenyi, 1998) and (Al-Qahtani, 2007), the quantitative methodology reflects the positivist thinking that observed phenomena are assessable. As per both of them, it is possible to generalize or to model them, especially in a mathematical sense.

In the quantitative approach considerable emphasis is given on statistical generalisation of findings that helps seek explanation and prediction of events in the social world. This is done by searching for regularities and causal relationship between constituent dependent and independent variables. This is because of the belief that the interacting elements affect each other in systematic and measurable means that can be validly warranted as knowledge. As per (Hussey and Hussey, 2003) this approach has been fairly popular with researchers until recently, however, it is deeply criticised by those who prefer qualitative research.

In fact, the quantitative research approach focuses on questions such as "How many?" and "How often?" which are easily processed in the form of numbers. The collected and compiled data is expressed and analysed numerically. The quantitative method uses standardised instruments like surveys and experimental observations wherein the changing perspectives and experiences of people are fitted to a limited number of prearranged response categories by assigning numbers as indicators.

The inherent merits of a quantitative method is that it has the potential to measure the reactions of a great many people to a limited set of questions, thus facilitating comparison and statistical aggregation of the data. This offers a great potential to express in a broad, generalised terms set of findings presented briefly and parsimoniously. As per (Al-Qahtani, 2007) quantitative research holds not only the advantages of statistical and numerical measurement, but also of subgroup sampling or comparisons. In addition, it offers an ideal opportunity for researchers to repeat the survey in the future to check, verify, validate and compare the results.

In summary, quantitative analysis that utilizes standardised instruments for measurement along with extended surveys of populations using representative, random, unbiased and statistically significant samples in surveys can be used only when the objective of the study is simple, clear and straightforward. In addition it can also be used to provide a base for starting an in-depth and comprehensive investigation that is fundamentally vital to the success of qualitative research process.

4.3.3 Triangulation approach

This approach as per (Al-Qahtani, 2007), offers numerous advantages, merits and benefits by including many sources of evidence and methods of analysis. It allows the researcher to focus and concentrate on a broader range of issues related to historical and behavioural aspects. As per (Flick, 2002), triangulation approach is comprised of The combination of different methods, study groups, local and temporal settings and different theoretical perspectives in dealing with a phenomenon". According to (Yin, 2003), this triangulation approach offers a unique way forward for the case study to become more realistic, precise and accurate. On the other hand researchers like (Brannen, 1995), and (Al-Qahtani, 2007), feel the potential of using triangulation to validate their results, thereby giving more confidence about their findings.

Neumann (2003), find that different methodological weaknesses can be easily cancelled by use of multiple methods to address the same problems. This offers a unique way, to produce more practical and simple findings that are close to real life situation. However, as per (Brannen, 1995) and (Al-Qahtani, 2007) triangulation approach is capable of offering a holistic picture to develop by capturing a more complete, holistic and contextual portrayal of the topic under study. (Neuman, 2003) advocate a combination of both quantitative and qualitative research styles as a useful tool in some studies. There are following common grounds and similarities between the two styles or approaches, which make them consistent. It helps derive inference as a way to examine empirical data to reach a conclusion. Involvement of a public method or a process is interesting since both collect, describe, examine data and document them. Both research methods strive to avoid errors and false conclusions.

Bryman (1988) and Al-Qahtani (2007) closely examined and analysed the situation in regard to merits and demerits of each of the qualitative and quantitative methods. This justifies need to combine both of them to get the best out of them in the form of a triangulation method. This is offered by other researchers to confirm the validity of conclusions. (Al-Qahtani, 2007) identified following four purposes by combining methods in a single study in situation that demand:

- Convergence of results.
- Overlapping different facets of a phenomenon that emerge from complementary methods.
- Use in sequence enables that the first method offers to help inform the second.
- Common perspective from contradiction.

4.4 Research methodologies

There are many types of research method that can be used to examine a research question. A research method is a statement of the way in which the researcher intends to collect the data essential to answer the research question. The research method describes the type of data, the amount of data to be collected, and the way in which data are to be collected. (Al-Qahtani, 2007) based on original ideas from (Colin, 2002) states that it is neither obligatory, nor necessarily good practice for the researcher to carry out one research method in isolation. (Al-Qahtani, 2007) based on ideas reinforces this view and assertion by suggesting the use of multiple and different sources, methods, investigators or theories to achieve the triangulation necessary to give the research its credibility i.e. best described as an approach known as the multi method approach.

4.4.1 Questionnaires

A questionnaire is a highly structured data collection technique whereby each respondent is asked written questions. (Gates, 2006) define questionnaire survey as a set of questions designed to generate the evidence necessary to accomplish the objectives of the research study. (Selltiz et al., 1981) argue that one advantage of questionnaires is that they are a comparatively low cost method of collecting primary data. They mention that the researcher could use unclosed or open ended questions when preparing the questionnaires. In addition, (Saunders, 2000) and (Al-Qahtani, 2007) state that questionnaires are often a tool for surveys, and since they have standardised data, it is easy to make comparisons, and they are generally reliable. Furthermore, they praise the questionnaire method, since it allows the researcher control over the research process in which data can be acquired straight without other sources of data supply being required. (Kerlinger, 1986) and (Al-Qahtani, 2007) argues that there are two major types of questionnaire survey. The first type is ‘exploratory’, and the objective is to become more familiar with a topic. The second type, and arguably the more important, is ‘explanatory’, and the objective is to find causal relationships among variables.

A questionnaire-based survey has the following advantages (Hussey and Hussey, 2003).

- It is cheaper than the interview, particularly when the sample number is large and respondents are widely spread over a large geographic area.
- It guarantees respondent anonymity, particularly important when the survey deals with sensitive issues.
- It minimizes bias errors that might result from interviewer influence.
- The respondent is given time to considered his/her answers, consult other people, and look into records before answering.

However, a questionnaire survey has the following disadvantages (Nachmias and Nachmias, 1996; Al-Qahtani, 2007).

- The biggest problem with the postal questionnaire is the low response rate.
- It is difficult to control who completes the questionnaire.
- The researcher has no opportunity to check the accuracy of the information received, interpret ambiguous questions, clarify ambiguous answers, or to appraise the nonverbal behaviour of respondents.

- The questionnaire survey requires simple and clear questions; hence the researcher will be unable to collect in depth data.

4.4.2 Interviews

Interviews are commonly employed as a way of gathering data from a relatively large number of people within a defined and targeted section of community, lending themselves well to a survey approach to research. Surveys conducted through interview are usually more costly. However, they permit the interviewer's personal influence and partiality to interfere, and may minimize the ability to maintain secrecy, which can be particularly important when sensitive issues are being researched. They are often preferable to questionnaire surveys because of the role the interviewer can play in enhancing respondent participation, guiding the questioning, answering the respondent's questions, and clarifying the meaning of responses (Hussey and Hussey, 2003). It is commonly believed that the interview allows the researcher to manage the interview situation. Thus it results in a higher response rate than the mail questionnaire. In addition, interviewer can help explore for additional and detailed data. On comparison it is obvious that the interview technique is preferable when asking longer, difficult, and open-ended questions (Al-Qahtani, 2007). Three types of interviews i.e. structured, semi structured and unstructured that are generally used can be described as below:

4.4.2.1 Structured interviews

In structured interview, questions are closed. The sequence in which questions are asked is the same in every interview i.e. repetitive. This type of interview is widely considered as more objective and easy to analyse. It is categorised as rigid with low or no flexibility (Nachmias and Nachmias, 1996; Al-Qahtani, 2007). Structured interviews are generally so designed so as to elicit specific details on a given issue as shown.

Advantages of structured interviews include:

- Attention is focused on a given issue. Detailed information is gained on issue discussed.
- Insight into declarative knowledge used is provided.

- General rules and problem solving strategies can be uncovered.

Disadvantages of structured interviews include:

- A full understanding of the important issue is needed to direct the interview.
- Concepts not contained in the focus of interview may not be found.
- It may provide weak insight into procedural knowledge.

4.4.2.2 Un-structured interviews

The unstructured interviews are designed and generally organised by interviewing stakeholders using open ended questions. This approach as per (Al-Qahtani, 2007) is not only laborious and time consuming but also difficult to analyse. However, this technique is widely believed as flexible and may be used to explore answers in greater depth. In summary, unstructured interviews are so designed so as to get a conceptual understanding of the problem solving strategy used by the expert. Table 4.1 shows both merits and demerits of unstructured interviews approach.

Merits	Demerits
Capable of enhancing the general understanding of the problem in situations when very little is known about the problem. Helps uncover important concepts that can eventually guide future enquiries. Offers insight into general problem solving method.	Attention not focused on a given issue. Very little factual information is provided. Few details on the concepts or objects are provided. Less detail provided on general concepts and objects.

Table 4.1: Merits and demerits of unstructured interviews

4.4.2.3 Semi-structured interviews

The semi-structured interview is designed to contain both open-ended and closed questions. Thus these interviews possess the advantages of both structured and unstructured interviews (Selltiz et al., 1981; Al-Qahtani, 2007).

4.4.3 Focus groups

Focus group is a group interview or a group conversation. It can play a valuable role in the generation of qualitative data. (Gilbert, 2001) and (Al-Qahtani, 2007) states that the focus group methodology differs from that of the individual interview in being dependent upon interaction between participants.

4.4.4 Case studies

Research methods based on case studies are generally used in different disciplines with different uses. Literature search by (AL-Qahtani, 2007) shows that it is difficult to obtain a clear definition. (Silverman, 2005) defines case study as “a general approach to studying a research topic”. (Saunders, 2000) describes the case study as “a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon with its real life context, using multiple sources of evidence”. (Hussey and Hussey, 2003) refer to case studies as “an extensive examination of a single instance of a phenomenon”. However, (Al-Qahtani, 2007) similar to (Yin, 2003) treats case studies as a representation of an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clear. In brief, case study approach is best used when the researcher thinks that the context of the fact which he/she investigates has an effect on this fact. (Yin, 2003) further argues that case studies represent a comprehensive research strategy. The case study as a research strategy, as referred to by (Yin, 2003), should include particular techniques for collecting and analysing data. (Stake, 1995) argues that case studies are not a methodological choice, but rather, they are a choice of what is to be studied. All the aforementioned definitions include an important description for case studies, and clearly refer to case study as being more a choice of a case and what is to be studied, such as a community or organisation, and not a research methodology by itself (Ryan et al., 2002).

The above critical review shows that as case studies represent a research strategy that includes the selection of a case; this does not involve that case study that should include just one case. Keeping this in mind (Yin, 2003) and (Al-Qahtani, 2007) identified following four possible designs for case studies:

- A single case design with single unit of analysis.
- A single case design with multiple units of analysis.
- Multiple case design with single unit of analysis.
- Multiple case design with multiple units of analysis.

The choice between these four designs as alternatives depends on the research questions, the nature of the cases, and the research conditions. (Ryan et al., 2002) finds that multiple designs can be used for two purposes, namely replication and theory development: similar cases might be selected to repeat the theoretical explanation, or different cases may be selected to extend the theory to a wider set of status. The above critical review shows that despite the benefits of the case study approach, it is not a problem free approach in research.

One of the major criticisms is concerning the issue of generalisation of the results based on case study. Thus keeping in view of the fact that most case studies usually include one case, or a few, this raises the issue of generalisation of case studies to a wider context. However, such a criticism is related to the view that case study is 'a small sample' by those who believe that the objective of research is to draw inferences about the population, which is consistent with the positivistic paradigm assumptions. Such criticism overlooks the real objective of case studies, which is not to confirm or falsify a theory for statistical generalisation, rather, either to explain, illustrate, explore, or explain.

Researcher partiality is another issue that forms as a critique of case studies. The researcher's partiality could lead to lack of rigor, a very important feature of good research. (Yin, 2003) found and argued that in case study research, lack of rigor has been more frequently encountered and less frequently overcome. Several alternative techniques are proposed that may lead to overcoming this problem, including that the materials should not be altered and the investigator must work hard to report all evidence fairly. (Ryan et al., 2002) and (Al-Qahtani, 2007) also found and suggested increasing objectivity and diminishing partiality in the collection and assessment of proof by using a team of multidisciplinary researchers with different backgrounds and experiences. He emphasizes on getting feedback and follows up by the researchers' interpretations to the subjects of the research.

4.4.5 Participant observations

Participant observation is a method of data collection where the researcher is fully involved with participants and the phenomena being researched. (Yin, 2003) describes observation in its practice as you do not ask people about their views, feelings or attitude; you watch what they do, and listen to what they say. The main advantages of observation are its directness. It enables researchers to study behaviour as it occurs. It also gives the possibility of recording events simultaneously with their spontaneous occurrence (Selltiz et al., 1976; Nachmias; Nachmias, 1996). However, there are following problems associated with observation techniques (Hussey and Hussey, 2003).

- The researcher cannot control variables in a natural setting.
- Problems of ethics, objectivity, and technology for recording what people say or do.
- Observer bias may arise.

Also, the observer sometimes fails to observe some activities because of distractions.

4.4.6 Sample design

A sample is simply a subset of a larger aggregation, typically a population. (Schaeffer et al., 1979) and (Al-Qahtani, 2007) define a population as the sum of units or people which a researcher wishes to study. It is indeed is the "process of obtaining information from a subset (a sample) of a large group (the universe or population)" (Mendenhall et al., 1971) and rightly confirmed by (Al-Qahtani, 2007). A population is seen to be a full group of people who represent a community, a society, an organisation, or anything that may have some common characteristics or criteria.

Sampling allows the researcher to recognize some unclear, unknown characteristics of the population. (Al-Qahtani, 2007) defines a population as the totality of units or people about whom the researcher requests to obtain information. A population is seen to be a complete group of people that constitute a community, a society, an organisation, or anything that may have some common characteristics or criteria. (Selltiz et al., 1981) and later (Al-Qahtani, 2007) state and consider a population as the aggregate of most of the cases that conform to some shared specifications. The specifications are determined by the goal of the research. Therefore, the term population refers to the entire group of people or things that the researcher aims to examine.

There are following different types of sampling designs, as described below.

4.4.6.1 Probability sampling

Probability sampling is based on chance selection procedures. Originally stated by (Sekaran, 2003) that in probability sampling every element in the population has a known nonzero probability of being selected. The selection of probability samples always observe certain mathematical or mechanical decision rules which are not subject to the discretion of the researcher.

4.4.6.2 Non-probability sampling

Non probability sampling, as based on the subjective judgments of the researcher, is usually used in exploratory research (Remenyi, 1998; Schutt, 2004) mentions that no probability sampling is likely to be helpful when the population is small or random sampling is not possible. In this type of sampling it is not likely to specify or categorise the probability of each unit in the sample. This implies that there is no chance for some units to be selected (Frankfort Nachmias and Nachmias, 1996). Non-probability sampling methods may cause losses when generalising problems. There are many types of non-probability samples, including haphazard, quota, purposive, and snowball (Neumann, 2003).

4.5 Justification of research methodology used

The selection of methodology depends on the aims, the objectives, the procedure of investigation, and the desired outcomes. A research problem in general refers to some difficulty that researcher experiences in the context of resolving a theoretical situation.

According to (Downey, 1977) the appropriateness of methodologies can only be determined and verified after applying to a specific research problem. This perspective treats methodology as a tool of inquiry, after careful selection.

4.5.1 Rationale for tools used for data collection

The rationale for using the chosen approach is dependent upon on the data collection and analysis methodologies. To meet this need as per (Al-Qahtani, 2007), the following criteria are adopted:

- Every question is introduced in more detail.
- Collection of data from such samples needs official permit.
- The respondents have limited time as they are HSE supervisors or managers and seldom have time for research activities like this.

Thus the type of collected information makes it feasible to:

- Manipulate independent variables.
- Meets study aims and objectives.
- Considers nature of respondents.
- Understands the limited nature of degree of control that the researcher has over the case under study.
- Needs low level of available Effort, time, and money.

The data collection is conducted in three stages and is done over a different period of time for each stage.

The analysis techniques (Al- Qahtani, 2007) used to provide the results in stage 3 is both qualitative and quantitative data analysis. The following statistical tools are used to analyse the collected data:

- Frequency distribution.
- Model distribution.
- Variation Ratio and Index of Diversity.

Frequency distribution and modal distribution is used to analyse the data that helped to:

- Gain a first impression of the level of awareness and commitment to Health Safety and Environment (HSE) Management in the Libyan oil and gas industry.
- Assess the nature and conditions of successful HSE management in the context of the oil and gas industry.
- Identify most important HSE performance indicators that influence the Libyan petroleum industry.
- Identify distribution of responses for the given indicators.

The statistical tools of Variation Ratio and Index of Diversity are used to analyse the data in to help:

- Identify the spread of responses on a scale 1 to 3, which indicated respondents' feedback of HSE aspects.
- Identify critical health and safety aspects with performance indicators in Libyan oil and gas industry.

4.5.2 Research design

The research methods developed are selected after taking into consideration the above stated aims and objectives of the research. In this research pertaining to oil sector in Libya a multi-method approach is chosen.

In Libya 'Health Safety and Environment Pays' is a common phrase that is commonly used, but when it comes to putting the concept into practice, very few are actually successful at it. There are many excuses made which include 'It is a waste of time' or 'it is costly' or 'it is not the main cause of failure'. The real problem, however, is that there is not enough guidance on how to improve health safety and environment management performance on site.

Inspections, job safety analysis and investigation are traditional approaches to measure the health safety and environment management performance for any site. However, the question is whether these statistics reflect the actual on site HSE protection effectiveness. The answer is usually that they do not. These numbers do not reflect the level of effectiveness of HSE protection management performance on site but often tell how lucky or unlucky the site has been. So, the key question, if this reactive approach does not portray the true picture, then what is the best approach. The industry needs a proactive approach, which is a new paradigm for measuring HSE protection management performance on the sites rather than just depending on the reactive data. Therefore, the first aim of this study is to design, develop and validate a structured review methodology for HSE protection management performance in respect of oil Industries (85% of the market) in Libya. Ideally, the methodology would have the potential for providing a generic framework to suit a wide variety of other industries.

The research methodology is described in the following points:

- Establish the awareness and commitment to HSE policy of key individual's influence across the Libyan oil and gas industry.
- Assess the applicability of HSE issues, aspects found from previous studies and relevant to the Libya based both domestic and international industry companies.
- Show elements of a best practice approach in relation to government policy motivating supervisors and HSE managers.
- Survey current thinking in Libyan oil and gas industry workplaces across company sizes by conducting personal structured interviews with the people who are responsible for health safety and environment in the company.
- Identify the critical HSE aspects which are applicable to the Libyan oil industry.
- Design and develop a structured HSE management performance review methodology for the oil and gas industry in Libya depending on the critical HSE aspects extracted.
- Develop a framework for a HSE management in Libya.

Figure 4.1 below shows the research methodology.

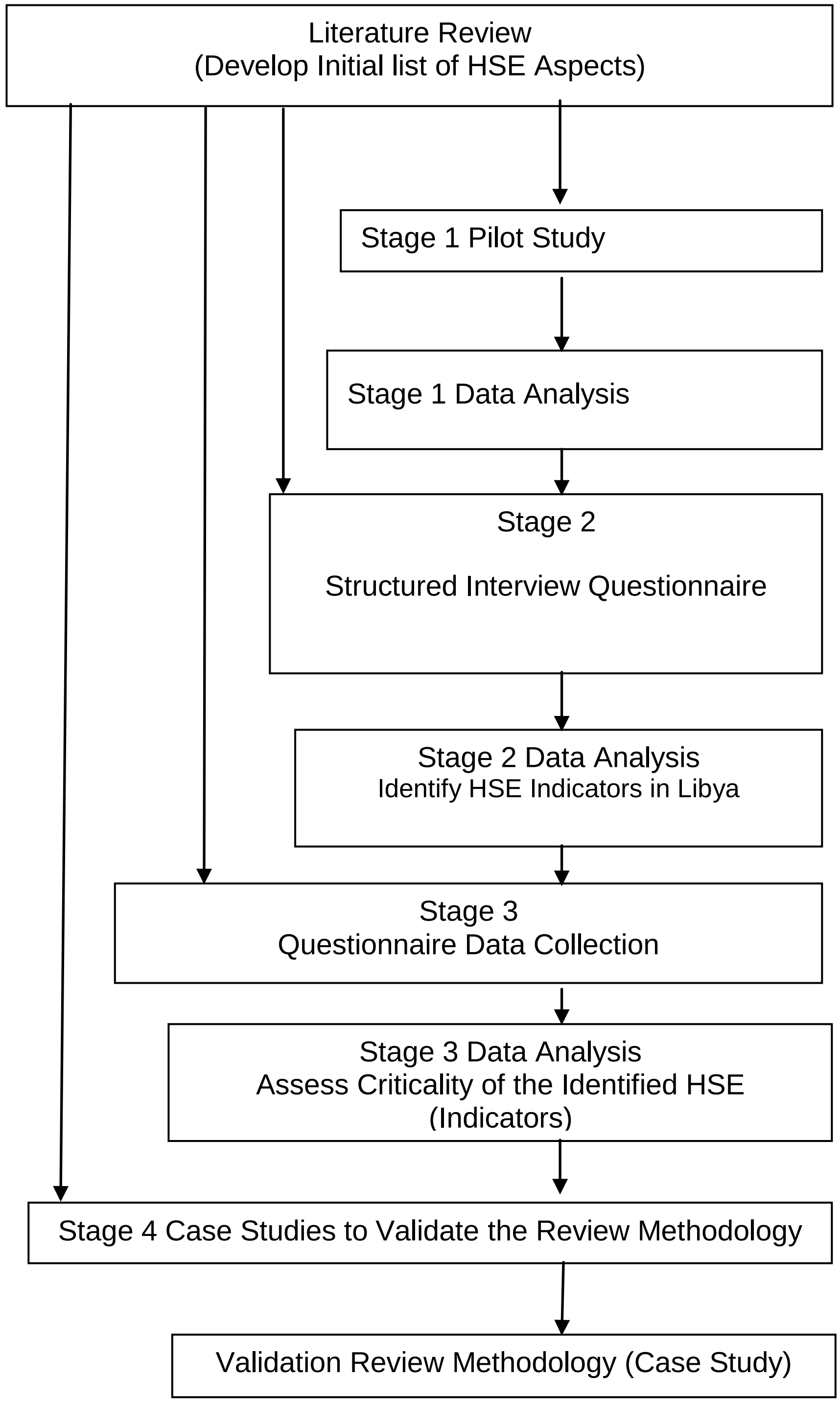


Figure 4.1: Research methodology

4.5.3 Translation of questionnaires

Initially during the four stages of surveys different questionnaires are designed in English language only. However, it is found that the use of Arabic language is more common amongst the respondents especially with Arabic background. English language is spoken widely as a second language in the oil and gas industry in Libya. Therefore, Arabic translation versions of all questionnaires are produced for Arabic speaking respondents.

Some English language terms especially related to modern HSE management are translated into the Arabic language by providing additional explanations so that respondents could understand them better. After translation, some HSE professionals who worked in different Libyan oil companies reviewed the Arabic language version of the interview questions. They were given both the Arabic and English versions and asked to help finalize Arabic version.

4.5.4 The Initial phase of data collection

This study is backed up by an extensive literature review and therefore it covers the qualitative side of investigation. The review covers a wide range of resources including journal and magazine articles, internet web sites, company annual reports, news bulletins, reports in related subjects and published case studies. The latest relevant books as sources for professional HSE practice and government published materials for statutory records like NIDA, EGA, LNCSM and NOC guidelines, regulations, methodologies, and so on is also extensively used. Other relevant published materials where required is gathered to complement the secondary data collection. Finally, an initial list of HSE indicators are derived as discussed in the end of Chapter 2.

The primary data collection stage resulted into and is called as three stages 1, 2, 3 and stage 4 case studies. The aim of Stage 1 is to establish the extent of awareness and commitment to HSE. This is collected by a survey method, using personal interviews on questionnaire on health safety and questionnaire on environment (see Appendices B, C and D) with the collaboration of qualified professionals from 35 companies in exploration and production. The data gathering was not easy, owing to the secrecy of operations of many companies' systems, and the fact that much of the information is not available for public consumption. However, participating respondents were highly appreciative and supportive of the research and did their best to facilitate the primary data collection.

If any major HSE indicator is missing in the course of study, it is may be considered as one of the limitations in sensitive data gathering in Libya. The companies selected are the ones that are representatives of major operating companies (both local, and multi nationals with local partners) in oil sector of Libya. They are both international and domestic companies. The selection criteria are based on their relevance to oil sector. They form a representative, unbiased and random sample.

The questionnaire designed is relevant to HSE situation in the oil sector of Libya. Questions framed are based on topics that are considered important in the profession in the context of Libya. Several other similar questionnaires from literature search were reviewed to find if they are relevant for socio-economic and cultural situation in Libya. Design questionnaire reflects HSE related matters that are of concern to stakeholders mainly in Libyan oil sector operators, professionals, impacted community and public.

4.5.5 The four stages of empirical research

Several assumptions, limitations and constraints that are peculiar to Libyan oil and gas industry are consider important in designing a research methodology to derive the stated goals and objective of this investigation. Some of the assumptions are that case study organisations have the following characteristics:

- They are willing, interested and cooperative.
- They permit access to supervisors and HSE and security managers.
- They have an understanding audience, willing to accept various research methods.
- They provide easy access to people, company information, and production area information.
- They have proven prior experience of HSE management system.

Case study companies with medium to high risks in oil and gas sector based on their past records are selected because the performances of supervisors and HSE managers in these companies offer a higher chance of preventing fatalities/deaths, injuries, permanent disabilities and property damages through accidents at work and care for the environment, health, security and safety of workforce.

Moreover, selected case study companies normally have both administrative and field staff, providing insights into the management of HSE and security across the range of risks along with regulations is. This is the most important government (NOC and EGA) created encouragement. Most of the interviewees approved that regulations and awareness influenced their approach to HSE protection issues, despite the fact that large international companies are more likely to be inspected and affected by experience rating of insurance premiums. Unexpectedly, small companies are just as encouraged by regulation as large companies.

It is evident that ethics and respect for rule of law plays a most important role leading to encouragement for managing HSE protection. However, some of the small companies do not put this into practice by systematically managing risks.

The researcher found that the desire to protect workers is the principal encouragement for supervisors and HSE and security managers to handle to HSE protection. It is found that the majority of supervisors had a positive supportive and responsible attitude to managing HSE protection; but there remains a remnant of about 20 to 25% of supervisors who are not responsible and fail to realize their duty towards HSE.

However, among small companies, there is a gap/space between theory and practice. While the supervisors of small companies in medium to high hazard oil and gas operations consider they are responsible for HSE and are complying with regulatory requirements, some are relying on informal approaches to managing HSE and security, rather than systematically and scientifically identifying their risks.

Most of the supervisors cited their learning and communications as an aspect, which encouraged them to attend to HSE matters. This suggests that personal liability, together with supervisors' stated concern for the HSE and security of their workers, is a powerful mix for encouraging supervisors.

4.6 Stage 1: Pilot study

The oil and gas industry routinely handles large quantities of toxic and highly inflammable material, upstream, midstream and downstream operations. Any loss of containment and operation is likely to lead to a major incident involving explosion, fire, injury, death, property damage and serious financial loss. Accidents cannot be rare enough because each will be serious. Supervisors and HSE managers play a very important role. Companies in the oil and gas industry normally have both administrative and field staff, which can provide insights into management of HSE across the range of risk.

A pilot study is an essential way to detect weakness in questionnaire carefully designed in terms of validity, reliability and practicality. This research also conducted in several stages and established the awareness and commitment to HSE protection, to assess the applicability of HSE indicators obtained from previous studies in Libyan oil and gas sector.

4.6.1 Stage 1: Survey sample

15 HSE professionals at all levels and with good experience have been selected for the pilot study. The key criteria for selecting the right companies for the pilot study include:

- The company is involved in the oil and gas sector in Libya.
- Access to HSE supervisors and managers is possible.
- Interviewees have proven HSE experience.
- Access to employees and general company information are possible.
- Company Management is sympathetic with the aims of the study.

The 15 HSE professionals selected represent upstream, midstream and downstream of oil sector in Libya. They have long working experience in the real practical work in HSE in oil and gas both within domestic and international companies. They were interviewed to gain a deeper insight into the company and also to give a different perspective result from a multidisciplinary, integrative inquiry and process over time. The 15 interviewees come from five of nine oil and gas companies selected. All five companies made the author sign a confidentiality agreement – This is the main reason for not disclosing their identities or the identity of their companies.

4.6.2 Stage 1: Interview questionnaire

The design for the interview question in the pilot study is based on previous literature review, especially for SPASE studies (Harms-Ringdahl, 2000), National Oil Corporation (NOC, 2009) technical survey report.

The interview questionnaire consists of the following key components:

I. Information about the oil company related organization and responsibility

1. Introduction.
2. How many people does your company employ?
3. What is your job title?
4. What does your job focus on?
5. Who would be involved in any actions taken to reduce risks from potential hazards at your workplace?
6. Reasons why you personally comply with the HSE regulations?
7. Is there a designated HSE manager for the workplace?
8. Are you the person responsible for final decisions on HSE for your company?

II. Statements about HSE practices.

1. Regulations and monitoring.
2. Management responsibility and enhancement.
3. Safety performance achievement.
4. Awareness.
5. Information resources.
6. Learning.

III. Statements about influences on workers in respect of HSE.

1. Compliance with regulations, inspection and standard.
2. Learning and communications.
3. Safety performance and reward.
4. Resources /intermediary pressure.

IV. System for reducing risks and hazards.

V. Sources used for HSE information.

VI. When does your company review existing risk assessment?

A full list of questions from the pilot study can be found in Appendix B.

4.6.3 Stage 1: Analysis of results

Interview quotes were studied and collected; categories of main issues were formed to explain different indicators of HSE integration in the selected company.

The interviews were focused on supervisors and HSE managers with medium to high hazards (oil and gas sector). This sector employs about 18 to 22% of the Libyan workforce, a few foreign experts and a lot of African and Asian low-skilled workers.

Data analysis in this stage identified the following HSE indicators considered important by the supervisors and HSE managers:

- Complying with standards, rules and regulations is the most important government created encouragement. Most of the interviews confirmed that regulation and awareness influenced their approach to safety first. Large companies are more likely to be inspected and affected by experience rating of insurance premiums. Medium companies were just as encouraged by standards, rules and regulations as large companies.
- Ethical duty seems to be the most important motivator in respect of HSE; small companies do not put this into practice by systematically managing risks.
- The desire to protect employees was the principal encouragement for supervisors and HSE managers. The interview results show that the majority of supervisors had a positive responsibility for managing HSE, but between 18 and 25% of them did not recognize their responsibility for the health and safety of those working alongside them. This was alarming.
- In small companies, there is a gap between theory and practice, mostly because of financial constraints.
- A lot of supervisors cited their learning and communication as an aspect which encouraged them to attend more to HSE.

4.7 Stage 2: Structured interviews

Stage 2 was designed to learn from the pilot study conducted in Stage 1 and formulate key questions for further investigation and analysis. The following issues have been identified for this purpose:

- HSE and security activities.
- Motivators of HSE.
- HSE management system.
- HSE external information sources.
- Performance measures.
- Communications and learning.
- Other areas that would focus upon HSE issues.

The main objectives of Stage 2 are:

- To establish the extent of HSE awareness and commitment of the companies in the study.
- To assess the applicability of HSE aspects, which have been found from pilot study, to Libyan oil industries companies.

4.7.1 Stage 2: Survey sample

The role, relevance, functions and importance of oil and gas industries in Libya have already been explained in more detail in Chapter 3. As obvious, petroleum industries in Libya are selected for their unique characteristics such as high risk industry, economic importance, major Libyan income generator, and researcher's previous experience. Oil industries in this research include all upstream, mid-stream and downstream related and services including petroleum products, refinery, petrochemical and other industrial branches, such as exploration and production, mid-stream transportation and downstream refining i.e. all those classified as petroleum industry according to the NOC and its sister organisations like Libyan petroleum Institute (LPI) and Petroleum Research Centre (PRC) in Libya.

Oil and gas industries case studies companies selected in this research pertain to include the ones that represent exploration and production upstream, refinery, petrochemical and other chemical industrial branches in midstream and downstream oil and gas industry.

It also includes oil and gas exploration and production companies that are NOC wholly owned companies and other international oil companies licensed by special participation and sharing agreements. Both the foreign and local companies' case study companies chosen cover wide areas, both onshore and offshore.

Companies that represent in Libya's onshore oil production are mainly located in three geological trends of the Sirte Basin: the Western Fairway, which includes several large oil fields (Samah, Beida, Raguba, Dahra-Hofra, and Bahi); the north-centre of the country, which contains the giant Deffa-Waha and Nasser fields, as well as the large Hateiba gas field; and an easterly trend, which has large fields such as Sarir, Messla, Gialo, Bu Attifel, Intisar, Nafora-Augila, and Amal. Overall, Sirt basin contains approximately 80 percent of Libya's proven oil reserves and accounts for 90 percent of production.

Companies located in new areas which have recently been put forward by NOC that are largely situated within the Ghadames and Murzuq basins, such as Field A in Block NC- 186, Kufra in the south-eastern desert.

Companies and their subsidiary are involved in downstream to refine close to 380,000 barrels/day of crude in its 4 refineries located in different parts of the country.

Ras-Lanuf Refinery operated by companies in the field of Libya's petrochemical industry is a major player utilising naphtha as a feed stock. Two ethylene plants with an annual capacity of 1.2 Million Metric tons yield main products like ethylene, propylene.

The three ports i.e. Es-Sider, Ras Lanuf and Brega have a combined export capacity of around 690,000 bpd. Survey study includes companies in Marsa Brega also.

The differences between upstream exploration and production energy companies (Group 1) and downstream refining Areas (Group 2) are treated as two different groups based on size, level of technology, partners' types, and relationship with the Authorities.

In this research, a range of practices and experience from oil and gas industry are compiled and not simply the best practice examples. HSE issues are treated on a global level. However, many local variations to emerging standards and legislation are found to exist in Libya.

4.7.2 Stage 2: Study administration

The respondents from case study companies in upstream, midstream and downstream answered the questions in a series of interviews, during visits that helped record verbatim for further analysis. All the meetings took place over a different period of time, and the respondents had enough confidence in the interviewer and trusted the confidentiality. This is done mainly for keeping respondents as comfortable as possible to get a true representation of facts and actual situation.

35 companies in oil and gas sector of Libya of different sizes and from different types in Tripoli, Benghazi and Sirt were visited during this comprehensive survey. Personal contacts are the most effective method to enable introduction to the selected case study companies and to reach the persons responsible in every company visited.

Micro, small and medium enterprise definitions are shown in Table 4.2.

Type of business	No. of Employees	Total assets
Micro enterprises	-	< 10,000 L.D
Small enterprises	< 25	< 1,000,000 L.D
Medium enterprises	> 25	< 5,000,000 L.D

Table 4.2: Libyan Definition of Micro, Small and Medium Enterprises in Libya

The survey sample consisted of **84 people from the 35 companies** chosen from oil and gas sector operational locations representing the entire industry in the country. The total sample from the companies, supervisors and HSE protection managers is stratified, so data are collected from supervisors of large, medium and small companies, and HSE managers in large and medium size companies. The present study thus uses an unbiased criteria by selecting a combination of quantitative and qualitative methods, by involving professionals fairly representing the entire population as samples from groups of case study companies. Table 4.3 below shows number of targeted professionals for implementing the performance review methodology from different sizes of the aforementioned case study companies.

	Small Co	Medium Co	Large Co	Total number of Professionals interviewed
Supervisors	10	17	13	40
HSE managers	0	26	18	44
Total	10	43	31	84

Table 4.3: Targeted Number of Professionals in Stage 1

4.7.3 Stage 2: Questionnaire

The main objective of the pilot research is to assess the nature and conditions of successful HSE management and security in the context of the oil and gas industry, and to identify most important HSE performance indicators that influence the Libyan petroleum industry. The list of questions are derived from Stage 1 research, that includes the following main headings:

- HSE activities and its motivators.
- HSE management system and its external information sources.
- Performance measures, continuous learning and capacity development.
- Other areas focused upon HSE issues.

To cover the above areas, 12 questions are identified as follows:

1. Is HSE an important issue to be managed by your company?
2. Which of the following would be the most important for your company to manage health safety and environment enhancement?
3. Which of the following would be the most important for your company to control health safety and environment risk?
4. Which of the following would be the most important for your company to evaluate health safety and environment performance?

5. Which of the following aspects influence the effectiveness of your company's activities in HSE?
6. Which of the following would be the most important motivators for your company to be active in the field of HSE?
7. Which of the following would be considered important reasons for you or your company when implementing HSE management standards?
8. Which of the following would be the most important sources for your company related to HSE matters?
9. Does your company monitor and measure its performance in relation to HSE?
10. Which of the following would be the most important motivators to encourage your company to use performance measures?
11. Which of the following learning activities are applied in your company regarding HSE matters?
12. What levels of the persons are involved for the learning in your company?

4.7.4 Stage 2: Data analysis methodology

The data collected from the structured interviews have been subjected to basic measures of central tendency analysis (Mc Cluskey, 2007) with the view to identifying the most commonly used HSE aspects within Libyan oil sector.

4.7.5 Stage 2: Data analysis results

0-49% modal frequencies as responses in Stage 2 interview questions phase are shown in Table 4.4.

Question	Freq.	%Freq.	HSE indicators
1b	4	05%	HSE not an important issue to be managed by Company.
1c	3	04%	No idea about importance of HSE issue to be managed by Company.
2e	21	29%	HSE training for newly-hired employees would be most important activity for Company to manage HSE enhancement.

2f	23	31%	HSE targets and objectives would be most important activity for Company to manage HSE enhancement.
3e	18	27%	Security system would be most important activity for Company to control HSE risk.
3f	19	26%	Medical examination of employees would be most important activity for Company to control HSE risk.
4b	28	38%	Near miss (incident) record would be most important activity for Company to evaluate HSE performance.
5f	25	34%	System of recognition and rewards influence on effectiveness of Company HSE activity.
5h	29	40%	Positive HSE culture influence on effectiveness of Company HSE activity.
5j	24	33%	Internal organisation influence on effectiveness of Company HSE activity.
5i	21	29%	Supervisor and line management training influence on effectiveness of Company HSE activity.
5g	17	23%	Management style influence on effectiveness of Company HSE activity.
6e	25	34%	Recent accidents would be most important motivator for Company to be active in field of HSE.
6i	28	38%	Meeting insurer expectations would be most important motivator for Company to be active in field of HSE.
6j	15	21%	Minimising insurance cost would be most important motivator for Company to be active in field of HSE.
6k	9	13%	Meeting trade/international trade requirements would be most important motivator for Company to be active in field of HSE.
6m	35	48%	Satisfying interest group would be most important motivator for Company to be active in field of HSE.
7c	22	30%	Trade and international trade would be considered important reason for Company when implementing HSE management standards.

7e	15	21%	Overseas parent requirement would be considered important reason for Company when implementing HSE management standards.
7g	32	44%	Eliminate non-conformance results would be considered important reason for Company when implementing HSE management standards.
7i	19	26%	Thought it was good idea would be considered important reason for Company when implementing HSE management standards.
8e	25	34%	Contact with industry group would be most important source for Company on HSE matter.
8f	14	19%	Advice from parent/partner company would be most important source for company on HSE matters.
8i	19	26%	Contact with leadership companies would be most important source for company on HSE matters.
8j	9	13%	TV, radio, and newspapers would be the most important source for company on HSE matters.
8k	20	27%	Internet would be the most important source for company on HSE matters.
9b	24	33%	Company generally does not monitor and measure its HSE performance.
10b	25	34%	Near-miss report learning activity applied in company regarding HSE matters.
10d	23	32%	Formal inspection learning activity applied in company regarding HSE matters.
11e	17	23%	Audit reporting and follow-up learning activity applied in company regarding HSE matters.
11f	15	20%	HSE suggestion learning activity applied in company regarding HSE matters.
11g	25	34%	Identifying root causes learning activity applied in company regarding HSE matters.

Table 4.4: 0-49% Modal Response Frequencies in Stage 2

Table 4.5 Modal frequencies based on percentage response to questionnaire 2 modal distribution: 50-100%.

Question	Freq.	%Freq.	HSE indicators
1a	64	87%	HSE is important issue to be managed by company.
2a	64	87%	HSE policy would be most important activity for company to manage HSE enhancement.
2b	39	53%	HSE manual and procedure would be most important activity for company to manage enhancement.
2c	41	56%	HSE Committees would be most important activity for company to manage HSE enhancement.
2d	46	63%	HSE prizes/rewards would be most important activity for company to manage HSE enhancement.
3a	44	60%	Job analysis in terms of HSE would be most important activity for company to control HSE risk.
3b	57	77%	Risk assessment would be most important activity for company to control HSE risk.
3c	50	68%	Emergency planning would be most important activity for company to control HSE risk.
3d	63	85%	Personal protective equipment (PPE) would be most important activity for company to control HSE risk.
3g	46	63%	Ventilation system would be most important activity for company to control HSE risk.
3h	37	50%	Chemical handling and labelling would be most important activity for company to control HSE risk.
4a	55	75%	Accident record and investigation would be most important activity for company to evaluate HSE performance.
4c	38	52%	Inspection and housekeeping would be most important activity for company to evaluate HSE performance.
4d	53	72%	Attitude / perception surveys would be most important activity for company to evaluate HSE performance.
4e	40	54%	HSE audits / housekeeping audits would be most important activity for company to evaluate HSE performance.

4f	51	69%	Financial losses (damage cost evaluation) would be most important activity for company to evaluate HSE performance.
5a	69	80%	HSE awareness influence on effectiveness of company activity in HSE.
5b	44	60%	Leadership commitment influence on effectiveness of company activity in HSE.
5c	69	94%	Supervisor and line management commitment influence on effectiveness of company activity in HSE.
5d	41	56%	Employee behaviour/attitude influence on effectiveness of company activity in HSE.
5e	56	76%	Employee participation influence on effectiveness of company activity in HSE.
5g	38	52%	Documentation and data control influence on effectiveness of company activity in HSE.
5i	39	54%	Internal communication influence on effectiveness of company activity in HSE.
5k	48	65%	Employee training influence on effectiveness of company activity in HSE.
5m	68	92%	Financial resource influence on effectiveness of firm activity in HSE.
5ol	40	54%	Performance evaluation influence on effectiveness of company activity in HSE.
6a	69	94%	Complying with regulations would be most important motivator for company to be active in HSE.
6b	64	87%	Expensive cost of accident/ill health would be most important motivator for company to be active in HSE.
6c	44	60%	Providing safe workplace for employees would be most important motivator for company to be active in HSE.
6d	39	53%	Publicity/images would be the most important motivators for company to be active in HSE.
6f	54	73%	Pressure from authorities would be most important motivator for company to be active in HSE.

6g	49	67%	Pressure from employees would be most important motivator for company to be active in HSE.
6h	49	67%	Meeting requirements of customers/local suppliers would be most important motivator for company to be active in HSE.
6I	39	53%	Satisfying society would be most important motivator for company to be active in HSE.
6n	50	68%	Pressure from industry organisation would be most important motivator for company to be active in HSE.
7a	55	75%	Good management procedures/tools would be considered important reason for company when implementing HSE management standards.
7b	49	67	Competitive advantage would be considered important reason for company when implementing HSE management standards.
7d	59	80%	Required customers would be considered important reason for company when implementing HSE management standards.
7f	46	63%	Facilitate compliance with HSE legislation would be considered important reason for company when implementing HSE management standards.
7h	59	80%	Improve HSE performance would be considered important reason for company when implementing HSE management standards.
8a	46	63%	Publications, journals, handbooks and books would be most important source for company on HSE matters.
8b	49	67%	Contact with relevant authorities would be most important source for company on HSE matters.
8c	59	81%	Visiting workshops/seminars/meetings would be most important source for company on HSE matters.
8d	70	95%	Information received from Chambers of Commerce would be most important source for company on HSE matters.
8g	36	49%	Advice from consultants would be most important source for company on HSE matters.
8h	39	53%	Advice from insurance companies would be most important

			source for company on HSE matters.
9a	48	65%	Company generally monitors and measures its performance in relation to HSE.
10a	46	63%	Promote goods and services would be most important motivator to encourage company to use performance measures.
10b	49	67%	Monitor performance would be most important motivator to encourage firm to use performance measure.
10c	51	69%	Comply with authorities would be most important motivator to encourage company to use performance measures.
10d	38	52%	Communicate performance to interested parties would be most important motivator to encourage company to use performance measures.
10e	60	81%	Improve HSE would be most important motivator to encourage company to use performance measures.
11a	53	72%	Accident investigation learning activity applied in company regarding HSE matters.
11c	38	52%	Unsafe act and condition report learning activity applied in company regarding HSE matters.
11d	40	54%	HSE meeting learning activity applied in company regarding HSE matters.
11g	42	57%	Team observation learning activity applied in company regarding HSE matters.
11h	49	67%	Enforcing safe job procedures learning activity applied in company regarding HSE matters.
12a	59	79%	Employees involved in learning exercise in company.
12b	39	53%	Supervisors line management involved in learning exercise in company.
12c	38	52%	HSE committee involved in learning exercise in company.

Table 4.5: 50-100% Modal Response Frequencies in Stage 2

In all, there are 92 indicators expressed in 12 questions. Out of the 92, there are 32 HSE indicators in a modal distribution of 0-49% response (Table 4.4), and 60 HSE indicators in modal distribution of 50-100% response (Table 4.5).

The 60 HSE indicators from the modal distribution 50-100% are used for further analysis in Stage 3 of the research. These are recognised as the most commonly used HSE indicators within Libyan oil companies and are selected to study their importance for the performance of these oil companies. These indicators demonstrate in the responses in Stage 2 that they play a significant role in the Libyan oil and gas industry HSE performance. Key observations from the analysis of data from Stage 2 interviews include the following:

- Among both supervisors and HSE managers, regardless of workplace size, a moral responsibility to “protect the safety of workers” is by far the most frequently mentioned driver of compliance with HSE regulations and implementing safe workplace practices, followed by the importance of adhering to rules and guidelines.
- While worry about loss of productivity due to workplace accidents is not influential on supervisors and HSE managers overall, it is most influential on HSE managers from medium company.
- Attitudes of both supervisors and HSE managers towards prevention and awareness practices are reported to be more supportive, understanding, and proactively compliant, rather than reactive to threats of penalties.
- Attitudes towards prevention and awareness practices are related more to the position in a company (supervisor versus HSE manager) than its size.
- Prevention and awareness statements are influential on interest in HSE among both supervisors and HSE managers, but they are more influential on HSE managers.
- Most supervisors do not agree that the penalties associated with non-compliance are higher than making the workplace safe.
- There is substantial support for surveillance for HSE regardless of respondent type or company size. Overall, the responses indicate that the vast majority of supervisors and HSE managers take a responsible approach to HSE and recognize the value of employee involvement in HSE monitoring.

- A clear majority of both supervisors and HSE managers, particularly within medium -size companies, agreed that “Strong senior management is the best way to make changes to HSE practices”.
- HSE managers demonstrate substantially greater levels of agreement for many Learning and communications concepts compared to supervisors.
- The majority of supervisors and HSE managers are aware of the Learning and communications benefits of HSE.
- Supervisors and HSE managers’ interest in HSE is greatly influenced by the possibility of HSE Learning and communications in their workplace.
- HSE managers are more likely to report HSE performance achievement to encourage HSE compliance than supervisors.
- Company’s size is not frequently influential in reporting HSE performance achievement; however, medium companies are more likely to monitor safety performance achievement.
- The desire or ability to monitor safety performance achievement increases as size of workplace increases.
- Safety performance achievement has greater influence on HSE managers’ interest in HSE than supervisors.’
- Both supervisors and HSE managers use a number of means of keeping up to date with developments and legislation changes. They use the HSE Fact file document; they are also involved in a number of committees.
- Overall, the majority of supervisors and HSE managers found it easy to find HSE information; however, supervisors in small organisations found it more difficult to do so compared with all other supervisors and HSE managers.
- Both supervisors and HSE managers’ well organised monitoring procedures at departmental level are effectively integrated within the companies’ safety management and enhancement structure.
- HSE managers are more likely to be involved in HSE matters, and they are able to comment on drafts of the self-assessment document both supervisors and HSE managers were able to promote HSE protection activities in a small workplace.

4.8 Stage 3: Questionnaire

The objective of Stage 3 is to identify the important and critical indicators that could affect the HSE performance and functioning of Libyan oil companies.

The modal distribution of data analysis results shown in Tables 4.4 and 4.5 for Stage 2 research formed the basis for Stage 3 research. Out of the total 92 indicators in 12 questions on 7 issues there are 32 HSE indicators in the modal distribution of 0-49% response (Table 4.4), and 60 HSE indicators in the modal distribution of 50-100% response (Table 4.5).

The 60 HSE indicators from the modal distribution 50-100% are used as the basis for Stage 3 of the research. These are recognised as the most commonly used HSE indicators within Libya based oil companies, and are selected to study their importance for the performance of these oil companies.

In stage 3 of the research, the key aim is to identify the criticality of these 60 HSE indicators identified from Stage 2 in terms of their importance in the performance of Libyan oil sector companies. A questionnaire is designed to measure the perceived criticality of these HSE indicators in the oil and gas companies in Libya.

4.8.1 Stage 3: Questionnaire design

The design of Stage 3 questionnaire is based on the questionnaire concept reviewed by (Al-Qahtani, 2007) and (Boicenkova, 2009), who themselves have based their survey on the original one, of (Thiagarajan, 1996). This was designed to measure the perceived importance of quality factors that play a role in TQM implementation in a company. A similar design is adopted to identify the perceived importance of HSE indicators, which influence the Libyan oil and gas industry companies' functions and their HSE management performance.

The 84 respondents were asked to rate each of the 92 indicators, on a scale of 1 to 3. The 60 HSE indicators are selected from out of 92 in Stage 3, indicating level of importance to HSE management performance. A response of 1 indicates 'critical', 2 ‘important’, and 3 “minor important”. The description of the rating of these indicators reflects relative importance as given below:

- **Critical**: Indicators perceived as critical are essential. The HSE management performance would end up in failure if these indicators do not exist in the HSEMS of the company.
- **Important**: These indicators are considered as important but not essential for the HSE management performance in the company. The performance process survives even if these are not fully/adequately addressed.
- **Minor important**: These indicators though somewhat important do not seriously affect the success or failure of HSE management performance.

Stage 3 questionnaire as used in this research is shown in Appendix D.

Boicenkova (2009) and Al-Qahtani (2007) emphasise that analysis and interpretation of the response to the questionnaire does allow objective judgment to be used in identifying consensus on the level of perceived importance of the stated indicators. The questionnaire contains simple statements of 92 HSE indicators similar to the 60 used by (Al-Qahtani, 2007) for inter industry comparison purposes screened from stage 2 of the research. The respondents are asked to rate their importance for case study Company selected from both domestic and international Libya based oil companies.

Based on similar logic as given by (Al-Qahtani, 2007) and (Thiagarajan, 1996), this research too emphasizes that analysis and interpretation of the responses to the questionnaire. It does allow objective judgment to be used in identifying consensus on the level of perceived importance of the indicators stated. Therefore, the designed questionnaire used in this research as per the logic explained earlier contains simple statement of 92 HSE indicators screened from Stage 2 of the research, and the respondents are asked to rate their importance for domestic and international Libya based oil companies.

The questionnaire is administered to the same sample of 84 supervisors and HSE managers from 35 domestic and international Libya based oil companies in oil sector business in Libya. The questionnaire is pretested prior to administration for errors in sentences.

An appointment is fixed with the respondents. The main objective of the questionnaire is explained and the respondents are asked to rate the importance of the pre-selected 60 HSE indicators on a scale of 1 to 3. The indicators are given in the questionnaire as simple statements without any leading questions. Respondents are assured of confidentiality of information provided.

4.8.2 Stage 3: Data analysis

Table 4.6 shows the frequency of the preselected 60 HSE indicators as arranged in random order. The Variation Ratio (Freeman, Linton C. 1965) and Index of Diversity, (Heip C, 1988) are calculated for critical and important factors.

No	Indicator	C	%	I	%	Mi	%
1	HSE issues to be managed by company	79	93.50	4	5.10	1	1.40
2	HSE policy to manage HSE enhancement	62	73.25	16	19	6	7.75
3	HSE manual and procedure to manage HSE enhancement	34	39.55	41	48.65	9	11.80
4	HSE committees to manage HSE enhancement	53	62.40	28	34.30	3	3.30
5	HSE prizes to manage HSE enhancement	57	66.66	23	28.04	4	5.30
6	Employees Job analysis in terms of HSE to control its risks	50	58.40	24	29.30	10	12.30
7	Risk assessment to control HSE risk	75	88.10	8	10.45	1	1.45
8	Emergency planning to control HSE risk	69	81.50	10	13.20	5	5.30
9	Personal protective equipment (PPE) to control HSE risk	82	96.20	1	2.40	1	1.40
10	Work place ventilation system to control HSE risks	61	72.50	20	24.25	3	3.25

11	Oil and gas product handling and labelling to control HSE risks	31	35.50	42	49.00	11	15.50
12	Accident record and investigation to evaluate HSE performance	71	84.10	11	11.10	2	4.80
13	Inspection and housekeeping to evaluate HSE performance	29	34.10	51	62.80	4	3.10
14	Attitude/ perception surveys to evaluate HSE performance	40	46.30	43	50.35	1	3.35
15	HSE audits/housekeeping audits to evaluate HSE performance	45	53.00	28	32.80	11	13.20
16	Financial losses (damage cost evaluation) to evaluate HSE performance	72	85.50	12	12.00	0	2.50
17	HSE awareness influence on effectiveness of company activity in HSE	79	93.60	4	3.05	1	3.35
18	Leadership commitment influence on effectiveness of company activity in HSE	34	39.55	46	53.25	4	7.20
19	Management commitment influence on effectiveness of company activity in HSE	57	66.20	25	28.70	2	5.10
20	Employee behaviour/attitude influence on effectiveness of company HSE activities	60	70.60	15	16.60	9	12.80
21	Employee participation influence on effectiveness of company HSE activities	62	73.30	17	19.30	5	7.40
22	Documentation and HSE data control influence on effectiveness of company performance	29	34.10	45	53.80	10	11.10

23	Internal HSE data communication influence on effectiveness of company activity	51	59.80	29	34.10	4	6.10
24	Employee training influence on effectiveness of company HSE activity	55	65.50	24	27.40	5	7.10
25	Financial resource allocation extent influence on effectiveness of company HSE activities	37	43.20	45	55.15	2	1.65
26	Performance evaluation influence on effectiveness of company activity in HSE	38	45.00	42	49.00	4	6.00
27	Complying with regulations as motivator for HSE	73	86.50	8	8.70	3	4.80
28	Expensive cost of accident and illness as de-motivator for HSE	59	69.50	19	21.70	6	8.80
29	Providing safe work place for employees motivator for HSE	62	73.30	17	19.30	5	7.40
30	Company publicity/images as motivator for HSE performance	34	39.55	45	53.35	5	7.10
31	Pressure from authorities motivator for enhanced HSE	68	80.30	12	12.50	4	7.20
32	Pressure from employees as motivator for HSE performance	53	62.50	20	25.10	11	12.40
33	Meeting requirements of customers as motivator for developing HSE – PRM	31	35.50	45	53.40	8	11.10
34	Stakeholders as motivator for developing HSE – PRM	28	35.10	33	38.80	23	26.10
35	Pressure from industry companies as motivator for HSE- PRM	75	88.20	8	8.45	1	3.35

36	Good management procedures/tools as reason for implementing HSE performance review methodology	62	75.90	12	13.90	10	10.20
37	Competitive advantage as reason of implementing HSE performance review methodology	34	39.50	37	46.60	13	13.90
38	Required customers satisfaction as a reason for implementing HSE - PRM	28	32.75	45	56.05	11	11.20
39	Facilitating compliance with HSE legislation reason for implementing HSE - PRM	45	53.40	35	41. 50	4	5.10
40	Improve HSE performance reason for implementing HSE - PRM	57	66.90	25	28.90	2	4.20
41	Publications, journals, handbooks and books source for company on HSE matters	35	40.90	43	50.75	6	8.35
42	Contact with relevant authorities source for company on HSE matters	45	53.05	35	40.90	4	6.05
43	Visiting workshops/seminars/ meetings source for company on HSE matters	63	76.20	14	16.20	7	7.60
44	Information received from EGA source for company on HSE- PRM matters	69	81.90	13	13.90	2	4.20
45	Advice from advisors important source for company on HSE- PRM matters	53	62.90	25	31.30	6	5.80
46	Advice from insurance source for company on HSE- PRM matters	26	30.50	46	54.40	12	15.10

47	Company should measure performance in relation to developing HSE- PRM	58	67.90	18	19.80	8	12.30
48	Services motivator for using performance measures in developing HSE- PRM	50	58.70	29	34.20	5	8.10
49	Monitor performance as motivator for using performance measures	54	63.85	27	30.10	3	6.05
50	Comply with EGA as motivator for using performance measures	47	55.90	27	34.20	10	9.90
51	Improve motivator for using performance measures in developing HSE- PRM	31	35.50	45	53.40	8	11.10
52	Improve HSE motivator for using performance measures	51	59.90	28	32.80	5	7.30
53	Use accident investigation as learning activity for HSE matters use unsafe act and condition report	64	76.60	17	19.30	3	4.10
54	learning as activity for HSE matters	32	38.40	48	54.40	4	7.20
55	Use HSE meeting learning activity for HSE matters	49	57.10	27	33.10	8	9.80
56	Use team observation learning activity for HSE matters	26	33.10	51	59.80	7	7.10
57	Use enforcing safe job procedures as learning activity for HSE matters in developing HSE-PRM	34	39.80	44	51.70	6	8.50
58	Employees involved in learning exercise in company	57	66.60	23	29.00	4	4.40
59	Management involved in learning exercise in company	52	61.50	19	23.30	13	15.20

60	HSE committee involved in learning exercise in company	33	41.10	43	50.40	8	8.50

C = Critical, **I** = Important and **Mi** = Minor important

Table 4.6: Distribution of Responses for 60 HSE Indicators Perceived as Critical, Important and Minor Important

4.8.3 Stage 3: Variation ratio analysis

As distribution of data may have similar centres with different amount of variations, the organisation of data into a frequency distribution and calculating the point of central tendency will not provide a satisfactory description of the problem. (Weisberg, 1992) emphasizes that centre measuring finds the typical value for a variable, while measuring the variability or spread of the response distribution tells us how typical that value is. This highlights the importance of finding the variability (spread) of the distribution. According to (Weisberg, 1992), there is no single agreed upon frequency-based measure of spread. It is therefore suggested to use several measures of spread rather than a single one (Carlson and Thorne, 1997). For metric variables, the appropriate measure of spread is variance standard deviation. The other appropriate measures of spread are Variation Ratio and Index of Diversity.

The Variation Ratio (VR) is the proportion of cases that do not fall into the modal category (Weisberg, 1992). It is an appropriate measure of spread of data for the investigation. Variation Ratio (VR) is calculated using the single formula: VR= 1 - (f mode / N), and that means VR = 1 frequency distribution of mode. N is number of respondents.

Unless the extent of consensus of the respondents on a particular factor of HSE is not satisfactory, the spread of response is difficult to identify, and because of this, Variation Ratio (VR) is used to measure the spread in this study. So, VR is computed to identify the extent of consensus on an objective basis in identifying a critical indicator, which affects the case study oil company. A value of zero means unanimity (all respondents rated a particular indicator as critical for oil companies). Values of 0.5 or less mean majority consensus while values more than 0.5 indicate no majority consensus in rating an indicator as critical. However, the VR does not take into account the full distribution of responses. The measure of spread that does so is the Index of Diversity.

4.8.4 Stage 3: Index of diversity analysis

Index of Diversity is defined as a dispersion measure based on a proportion of cases in each category (Weisberg, 1992) and (Heip, 1988) In mathematical terms Index of Diversity =1 – {(P1) 2 + (P2) 2 -- - - - - - - - (Pk)2 } = 1 − ∑ P2k and ∑ stands for summation, where Pk is the proportion of cases in category k, and k is the number of categories. For example, if 84% of the respondents rated an indicator as critical, 9% rated it as important, and 7% rated the same indicator as minor important, then the Index of Diversity is measured as: Index of Diversity = 1-[(0.84) 2 +(0.09) 2 +(0.07)2]= 0.28

This index shows the degree of concentration of responses in a few large categories, as squaring proportion emphasizes the large proportion much more than the small ones (Weisberg, 1992). Thus, the Index of Diversity can be considered as a substitute measure of agreement among the respondents concerning the response distribution of each of the indicators. A low index value means general agreement on the importance of an aspect, while a high index value means general disagreement. This means that an index value close to zero will imply near unanimity. A value close to 0.05 is, when there is equal cluster (concentration) around two large categories. A near uniform distribution in the three rating categories will give a maximal value close to 0.06, which will mean high level of disagreement. Table 4.7 shows the modal distribution of critical HSE indicators (N=40) N number of respondents.

No	Indicator	Variation Ratio	Index of Diversity
1	HSE issues to be managed by company	0.04	0.09
2	HSE policy to manage HSE enhancement	0.25	0.33
4	HSE committees to manage HSE enhancement	0.35	0.47
5	HSE prizes/rewards to manage HSE	0.31	0.46

	enhancement		
6	Job analysis in terms of HSE to control health and safety risk	0.40	0.54
7	Risk assessment to control health and safety risk	0.10	0.18
8	Emergency planning to control health and safety risk	0.17	0.29
9	Personal protective equipment (PPE) to control HSE protection risk	0.02	0.04
10	Ventilation system to control health safety and environment risk	0.26	0.40
12	Accident record and investigation to evaluate health safety and environment performance	0.14	0.25
15	HSE audits/housekeeping audits to evaluate health safety and environment performance	0.45	0.57
16	Financial losses (damage cost evaluation) to evaluate HSE performance	0.13	0.22
17	HSE awareness influence on effectiveness of company activity in HSE	0.04	0.19
19	Supervisor and line management commitment influence on effectiveness of firm activity in HSE	0.31	0.44
20	Employee behaviour/attitude influence on effectiveness of company activity in HSE	0.27	0.43
21	Employee participation influence on effectiveness of company activity in HSE	0.25	0.39
23	Internal communication influence on effectiveness of company activity in HSE	0.38	0.49
24	Employee training influence on effectiveness of company activity in HSE	0.33	0.47
27	Complying with regulations motivator for HSE	0.11	0.21
28	Expensive cost of accident/ill health motivator for HSE	0.29	0.47

29	Providing safe work place for employees motivator for HSE	0.25	0.39
31	Pressure from authorities as motivator for HSE	0.18	0.31
32	Pressure from employees as motivator for HSE	0.35	0.51
35	Pressure from industry organisation motivator for HSE	0.14	0.18
36	Good management procedures/tools reason for implementing HSE management standards	0.25	0.40
39	Facilitate compliance with HSE legislation as reason for implementing HSE management standards	0.45	0.53
40	Improve HSE performance reason for implementing HSE management standards	0.31	0.44
42	Contact with relevant authorities source on HSE matters	0.45	0.52
43	Visiting workshops/seminars/ meetings source on HSE matters	0.23	0.38
44	Information received from Chambers of Commerce source on HSE matters	0.17	0.29
45	Advice from consultants source on HSE matters	0.35	0.49
47	HSE performance should be monitored and measured	0.30	0.46
48	Promote goods and services motivator to using performance measures	0.39	0.47
49	Monitor performance motivator to using performance measures	0.34	0.51
50	Comply with authorities motivator for using performance measures	0.42	0.55
52	Improve HSE important motivator in using performance measures	0.38	0.50
53	Using accident investigation as learning activity regarding HSE matters	0.22	0.36

55	Using HSE meeting as learning activity regarding HSE matters	0.41	0.54
58	Involve employees in learning exercise	0.31	0.46
59	involve supervisors and line management in learning exercise	0.37	0.53

Table 4.7: Critical HSE Indicators (N=40)

The result of the important HSE indicators (N=20) shows below in Table 4.8.

No	HSE indicators	Variation Ratio	Index of Diversity
3	HSE manual and procedure to manage HSE protection enhancement	0.58	0.57
11	oil and gas product handling and labelling to control HSE risk	0.62	0.59
13	Inspection and Housekeeping to evaluate HSE protection performance	0.64	0.50
14	Attitude/ perception surveys to evaluate health safety and environment performance	0.52	0.50
18	commitment influence on effectiveness of company activity in HSE	0.58	0.53
22	Documentation and data control influence on effectiveness of company activity in HSE	0.64	0.56
25	Financial resource influence on effectiveness of company activity in HSE	0.54	0.50
26	Performance evaluation influence on effectiveness of HSE activities of company	0.53	0.52
30	Publicity/images motivator for HSE	0.58	0.53
33	Meeting requirements of customers/local suppliers motivator for HSE	0.62	0.55
34	Satisfying society motivator for HSE	0.65	0.65

37	Competitive advantage reason to implement HSE management standards	0.58	0.60
38	Required customers reason to implement HSE management standards	0.65	0.57
41	Publications, journals, handbooks reports and books as important source on HSE matters	0.57	0.55
46	Advice from insurance companies source on to HSE matters	0.68	0.57
51	Communicate performance to interested parties as motivator for using performance measures	0.63	0.55
54	Applying unsafe act and condition report as learning and growth activity regarding HSE	0.60	0.53
56	Applying team observation as learning activity regarding HSE matters	0.68	0.51
57	Applying enforcing safe job procedures as learning activity regarding HSE matters	0.58	0.46
60	Involving HSE committee in learning exercise	0.60	0.56

Table 4.8: Important HSE Indicators (N=20)

4.8.5 Stage 3: Analysis of results

From the 84 questionnaires, it is found that the respondents had rated 40 indicators as critical (Table 4.7) because they gave higher frequency to critical compared to important and minor important. The respondents rate 20 indicators as important (Table 4.8) because they give higher frequency to important compared to critical and minor important, and none of the respondents has rated minor important with higher frequency compared to critical and important. Hence, the modal distribution of frequency of responses is in two categories, critical and important.

After the modal distribution of the indicators in critical and important categories, the Variation Ratio can be computed to identify the extent of consensus on an objective basis in identifying a critical indicator, which affects the oil companies. A value of zero means unanimity (all respondents rated a particular indicator as critical for oil companies). Values of 0.5 or less mean majority consensus, while values greater than 0.5 indicate no majority consensus in rating an indicator as critical. However, the VR does not take into account the full distribution of responses. Moreover, Index of Diversity can be considered as a substitute measure of agreement among the respondents concerning the response distribution of each of the indicators. A low index value means general agreement on the importance of an aspect, while high index value means general disagreement on its importance. This means that an index value close to zero will imply near unanimity. A value close to 0.5 is when there is an equal cluster (concentration) around two large categories. A near uniform distribution in the three rating categories give a maximal value close to 0.6, which means high level of disagreement.

In the current analysis, the striking features are responses of respondents in rating the HSE indicators of 'Personal protective equipment (PPE) to control health and safety risk', 'HSE issues managed by the company 'HSE awareness', 'Pressure from industry organisation as motivator for HSE, and 'Importance of risk assessment to control HSE risk' as critical indicators that affect the HSE management performance in the Libyan oil sector companies because the values of Variation Ratio and Index of Diversity for these HSE indicators are close to 0.5.

The Variation Ratio and Index of Diversity for each of these indicators are shown in Tables 4.7 and 4.8 above. The indicators with a value greater than 0.5 in the Variation Ratio means that Index of Diversity is not critical.

4.9 Discussions

The first part of this chapter discusses the HSEM framework research design and methodology of this research after reviewing the state of the art on relevant research approaches and methodology, OGP practices and guidelines. The chapter briefly outlines quantitative and qualitative research, and concludes that neither is superior to the other. Consequently, the triangulation approach is found to be more suitable for combining the quantitative and qualitative approaches to collect data, analyse it, and for its possible use to validate the review methodology developed in Chapter 5 for case studies.

Personal interview surveys are used for identified five case studies companies out of the total 35 companies representing up stream, midstream and downstream of the entire Libyan oil and gas sector. The second part of this chapter discusses analysis of data collected from the pilot study stage 1, interviews stage 2 and the questionnaires stage 3. The critical and important HSE indicators, which are perceived as vital for the oil and gas industries companies in Libya, are identified from stage 2 of the analysis. Variation Ratio and Index of Diversity are calculated for analysis of factors in respect of 60 indicators by 84 respondents. It is found that critical and important factors are the main contributors to HSE indicators.

It is indicated that most of the HSE indicators rated as critical for the functioning of the oil and gas service related companies are similar to the ones discussed in the literature review (Johnsen et al., 2013) and identified in similar research findings targeted to oil and gas industry. Some ideas given by earlier studies (Harms Ringdahl et al., 2000) and the National Occupational Health and Safety Commission (2001) are found equally useful.

Striking features emerged from responses in rating the HSE indicators of Personal protective equipment (PPE) to control HSE protection risk HSE issues managed by company HSE awareness Pressure from industry organisation as motivator to HSE and 'Importance of risk assessment to control HSE risk' as critical indicators that affect the HSE management performance of the oil sector in the country.

The critical HSE indicators are similar to the one by earlier studies in petrochemical industry by researchers in one of the biggest oil companies. These are found to be fruitful for its adoption by Libyan HSE authorities especially the NOC. These indicators from motivated target groups are summarised HSE aspects and can be treated as distinct groups.

Chapter 5: DEVELOPMENT OF A HSE PERFORMANCE REVIEW METHODOLOGY FOR THE OIL AND GAS INDUSTRY IN LIBYA

This chapter presents specific health safety and environment management aspects relevant to oil sector case study industries in Libya. It explains the outcome of the ongoing debate on what nature, type and sort of actual HSE management is achievable, bearing in mind the nature and diversity of the sector. It also highlights more precisely the answers to questions like how improvement is to be made and how HSE management might be reviewed and measured. The need for proactive measurements in lieu of conventional reactive measurement such as accident frequency, which falsely assumes that accidents are the measures of health safety and environment management system, is indicated. The objective is to review methodologies that are able to help reduce the potential for future accident or incidents on site in addition to reporting changes, identifying contributing factors to the causes of accidents, reviewing the safety culture of companies, and also providing remedial actions to be taken. A process based structured review methodology for enhanced HSE management performance relevant to Libyan oil and gas sector related industries is outlined. It presents results and resource framework pertaining to HSE protection aspects developed as outcomes, outputs, base line, target, activities and performance indicators derived from a series of discussions with experts, and structured interviews at companies related to oil sector in Libya.

5.1 Rationale for the HSE performance review methodology

In Libya ‘Health Safety and Environment HSE) Pays’ is a popular saying. Indeed it is widely considered as a lip service only. In practice the concept is rarely used by a few that are actually successful at it. There are several lame excuses like ‘It is a waste of time’ or ‘it is costly’ or ‘it is not the main cause of failure’. Indeed the real problem lies mainly because of not enough guidance on how to improve HSE protection management performance on site.

Review shows that inspections, job safety analysis, audits and investigation are some of the common traditional approaches that are extensively employed to measure the HSE protection management performance for any site. It is increasingly felt that statistics to reflect the actual on site health safety and environment HSE situation are seldom meaningful and effective. The measurement in terms of numbers does not adequately reflect the level of effectiveness of HSE protection management performance on site. It simply reflects and often tells how lucky or unlucky the site has been. This clearly reveals that reactive approach does not portray the true picture. The best approach needs to be a proactive approach. This is a new paradigm for measuring HSE protection management performance on the sites rather than just depending on the reactive data.

5.1.1 Background

Review methodology for health safety and environment management performance is in line with the one initially developed by the Quality Assurance Agency for Higher education (QAA) in the UK, with required amendments and produced independently. QAA engagement team talks to employers to understand what they need and expect. Alongside QAA works with higher education providers to increase their collaboration with employers (QAA, 2014). QAA has also representatives from enterprises like business on its Board, and invites professional, statutory and regulatory bodies to contribute to its guidance, in particular the subject benchmark statements which are essential for setting standards. QAA also publishes topical guidance that equips graduates with relevant and work-related skills in areas for sustainable development. It is used by (Al-Qahtani, 2007) for design development and validation of structural review methodology for health and safety in chemical industry. The QAA mission is intended to safeguard the public interest in sound standards of higher education qualification in tertiary education systems. Its purpose is to encourage continuous improvement in the management of the quality of higher education in cooperation with higher education institutions in educational fields. The objective in respect of educational field is to help define academic standards and quality, and carry out and publish reviews against these standards.

QAA Case Study for Higher Education examines an Institutional Review Action Plan progress report of (2014). This action plan addresses the recommendations and affirmations made by the QAA Institutional Review Team following its Review. It demonstrates how the plans assist to capitalize on existing good practice.

In order to test a similarity between QAA Case Study for Higher Education and Performance Review Methodology (PRM) for Case Study for oil and gas sector in Libya a review team reviewed Institutional Review Action Plan – progress report. Comparison of pilot results from before and after study as indicated in Fig 5.1 between the Oil and Gas HSE review aspects with QAA aspects shows a fair degree of similarity between the two.

On the other hand, the purpose of the review methodology is to describe the methods and procedures for carrying out reviews to evaluate the effectiveness of HSE protection performance in the case study oil companies in oil sector of Libya. Figure 5.1 given below shows the mapping between the QAA Subject Review Method (SRM) aspects and the HSE Management Performance Review Methodology (MPRM) aspects. It includes protocol, procedures and practical organisations of review from advanced planning through to the publication of reports.

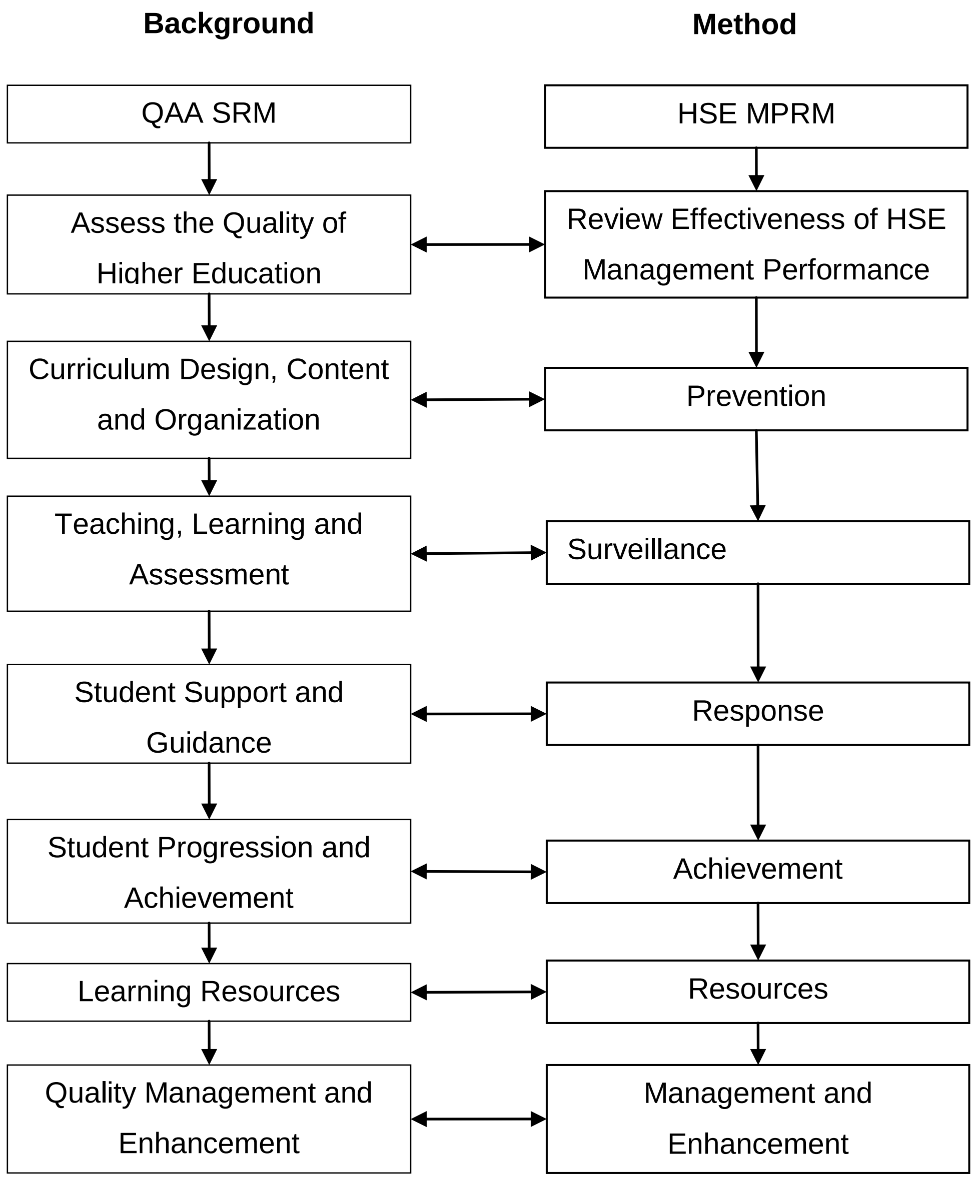


Figure 5.1: Mapping HSE Review Aspects with QAA Aspects

In summary the aims of this review methodology include:

- Identifying defining and encouraging rectification of major shortcoming in HSE.
- Identifying defining and encouraging improvements in HSE through the publication of review reports and through the sharing of best practice.
- Provide, through the publication of reports, effective and accessible information on the HSE in the case study companies reviewed.

From the data obtained using empirical research, the critical HSE performance indicators thought to be relevant and fruitful for HSE authorities and other stakeholders to use in motivating the target groups are sorted and screened out. These are summarised, categorised and grouped into six HSE aspects. These six HSE aspects are used to develop a structured HSE performance review methodology in respect of case study oil companies in Libya. The six HSE aspects with their performance indicators are identified and given below in the next section.

5.1.2 Identification of HSE performance review aspects

Based on comprehensive surveys interviews, discussion meetings and literature search, the data analysis results are obtained using the structured interviews in respect of case study oil companies in Libya. It is possible to identify important and critical indicators for successful HSE management performance in respect of Libya based both domestic and international companies. These six HSE aspects as referred above form the basis for the proposed review methodology.

As obvious, the identified 6 HSE aspects provide a common structure for each stage of the review process. This involves the self-assessment, the review visits, the judgments and the review reports.

The following identified six aspects for review by a review team established based on the criteria and its composition is given elsewhere (Chapter 6).

- Prevention.
- Surveillance.
- Response.
- Achievements.
- Resources.
- Management and Enhancement.

The above HSE aspects are sufficiently broad and inclusive to help enable case study oil companies.

As expected the profile is designed and created by applying a grade (Table 6.4) to each of the six aspects. The assignment of grades is a matter for the professional judgment of the review team during the review visits.

As given earlier in Chapter 4 pilot study herein called as stage 1 is carried out to establish the awareness and commitment to health safety and environment, and to assess the applicability of HSE indicators. After the experiential learning from pilot study, structured interviews are conducted to identify the most commonly used 92 HSE indicators within Libyan oil sector operating companies from Stage 2. Finally, the criticality of the 60 indicators is identified in terms of their importance in the performance of Libyan oil Sector related upstream, midstream and downstream Stage 3. Exploration and Production companies pertain to up stream. Oil pipeline transport companies are treated as midstream Petrochemical and refinery companies are considered as downstream.

The criteria and procedure for grouping of the HSE aspects for application of developed performance review methodology is given based on brain storming sessions by specialist i.e. the professionally experienced (five years or more) and higher degree qualified (university/technical colleges/higher institute) review team as shown with details in table 3.4. This approach served as a scientific process for the validation of developed performance review methodology.

Figures 5.2, 5.3 and 5.4 for mapping of 4 identified research problems after every stage is given below. It shows the indication to which each health safety and environment performance review aspect is related to identify research problems. This is similar to HSE performance review aspects related to one or more of the health safety and environment problems obtained from the review given in empirical stages.

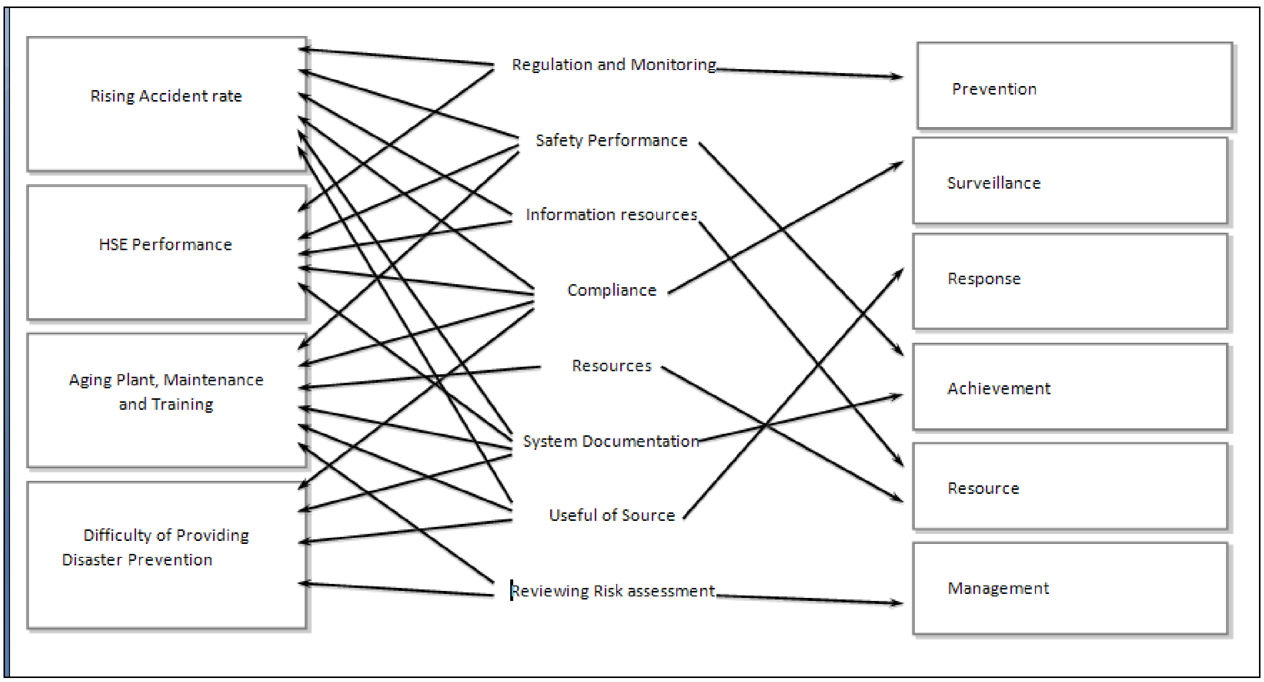
5.2 Rationale for developing the HSE performance review methodology

Rationale for developing HSE performance review methodology using mapping of assessment of selected safety performance evaluation methods (Sgourou, 2010) in regards to their conceptual, methodological and practical characteristics is based on

(Sgourou and Katsakiorib, 2010). In addition, the objective of prevention of Occupational Accidents in a Changing Work Environment's given in Safety Science. The six aspects of the HSE - P R M given in this thesis have been derived commensurate with the four identified research problems discussed in Chapter 3 as well as the results of the three stages of empirical research as outlined below.

5.2.1 Mapping of HSE review methodology with stage 1 research

A mapping showing the relationships between the four research problems and the six aspects of the HSE Performance Review in respect of Stage 1 are shown in Figure 5.2.



Source (NOC and LPI technical study report, 2009)

Figure 5.2: Mapping of Research Problems Vs Stage 1 Vs HSE Performance Review

5.2.2 Mapping of HSE review methodology with stage 2 research

A mapping showing the relationships between the four identified research problems and the six aspects of the HSE Performance Review in respect of Stage 2 are shown in Figure 5.3.

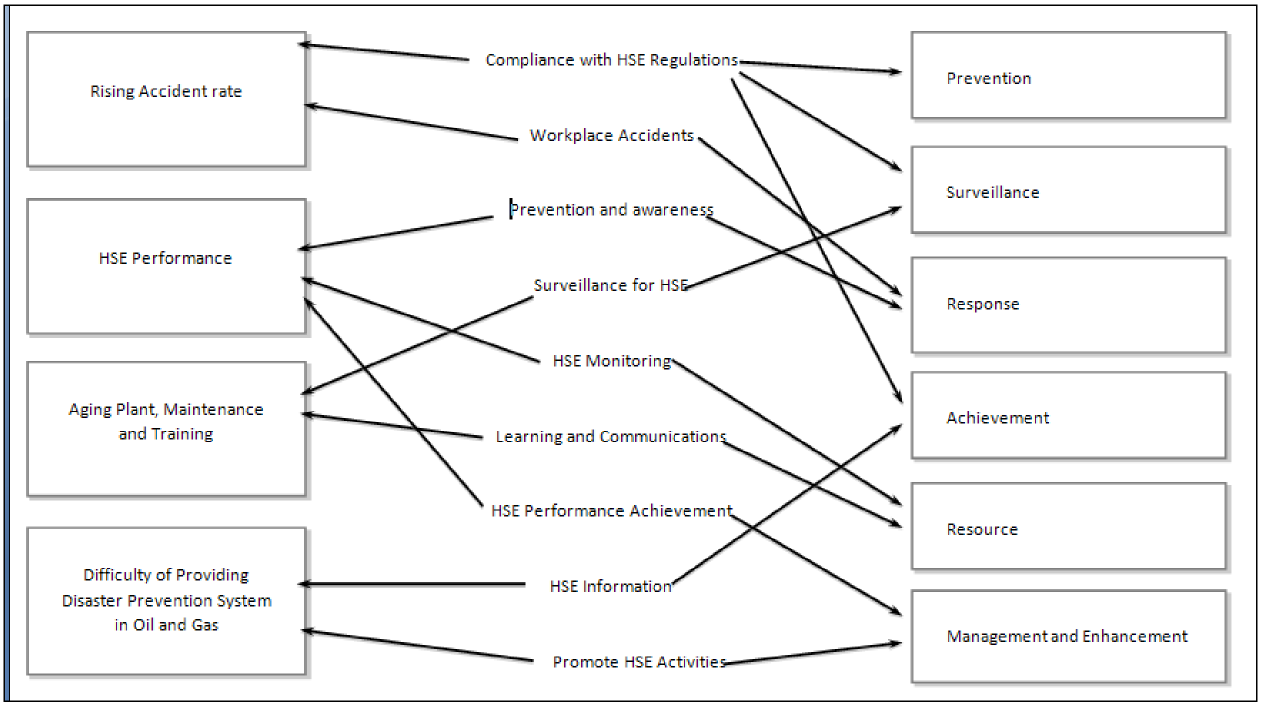


Figure 5.3: Mapping of Research Problems Vs Stage 2 Vs HSE Performance Review

5.2.3 Mapping of HSE review methodology with stage 3 research

A mapping showing the relationships between the four identified research problems and the six aspects of the HSE Performance Review in respect of Stage 3 are shown in Figure 5.4.

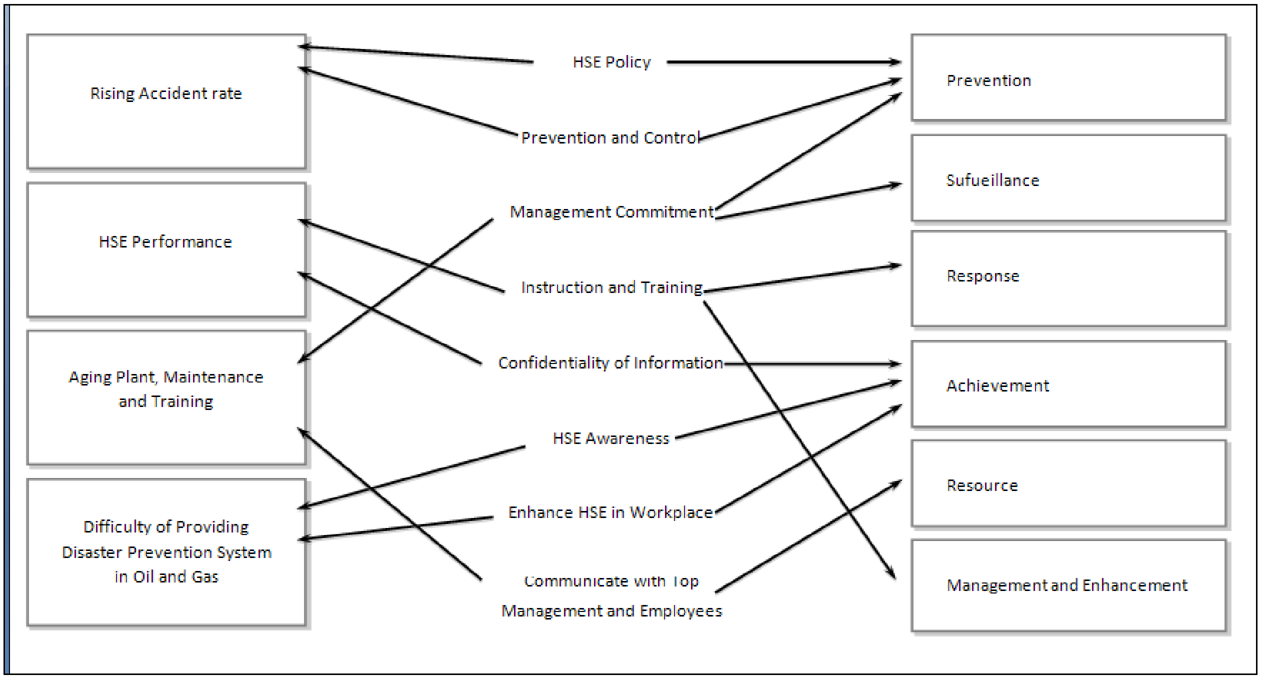


Figure 5.4: Mapping of Research Problems Vs Stage 3 Vs HSE

5.2.4 The grading of the six HSE performance review aspects

After in-depth review, several brain storming discussions with the review team and in line with other similar scales, it has been decided to base the review methodology on the following four point scale each with a clear outcome as shown in Table 5.1 below.

Grade	Qualifier	Description
4	Standard exceeded	Commendable: Above the required levels of performance
3	Standard met	No shortfalls: achieving the required levels of performance
2	Standard almost met	Minor shortfalls: no major deficiencies and required levels of performance seems achievable without extensive extra activity
1	Standard not met	Major shortfalls: significant action is needed to achieve the required levels of performance

Table 5.1: HSE Aspects Scale Points

The above ranking and rating system based upon the grading points is designed and developed to ensure that no matter how good the procedures are 'on paper', unless there is evidence of their being successfully and routinely used on a day today basis.

The decision making process based on judgments for 'practice' rather than 'theory' are similar to the one as echoed down in the grading points system originally advocated by UK based (Health and Safety Executive, 2000). This is further modified based on the observations, recommendations and suggestions that advocate the rationale of an oil companies approach to health safety and environment management needs to supported and reliant on a key person, or key people. This must be reflected in evolving the basis for rational grading.

5.3 Descriptions and discussions of the six HSE performance review aspects

The following sections provide a basis along with rationale to describe the six HSE protection aspects identified from comprehensive state of the art literary and empirical research. Each of the six aspects is described using a list of key areas in terms of the typical evidence required. The list of areas provided although not exhaustive still forms a basis to provide a true reflection of holistic or completed picture.

5.3.1 Prevention aspect

This aspect covers all dimensions related to work carried out to prevent HSE protection incidents and accidents from happening in the first place. It includes the following four areas:

5.3.1.1 Hazard identification

How structured are the methodologies used to identify all aspects of the HSE including:

- A consistent risk assessment model with clearly defined risk attributes.
- An organised methodology clearly showing what might go wrong, how it might go wrong, what might cause it to go wrong, and what options are available.
- Latest and recent developments and innovations in the field.

- Expert advice and professional approach where relevant.

5.3.1.2 Hazard mitigation

This depends on understanding of how appropriate are the control measures and emergency plans in relation to the working environment keeping in mind.

- The staff profile.
- The hazards identified.
- External and internal reports on the effectiveness of the control measures.

5.3.1.3 HSE protection awareness

This depends on understanding of How motivated trained matured and concerned are the staff members in recognising and observing health safety and environment rules and regulations keeping in view:

- The working conditions and required enabling environment.
- The traditions, habits, customs, value system and culture of the company.
- The concerns of stakeholders, rules, norms, laws and regulations of controlling bodies.

5.3.1.4 Currency and innovation

This aspect requires understanding of the fact that how hazard management is informed and influenced by developments in physical resources.

The knowledge of the above-referred context does assist in readily linking it to the performance indicators. It pertains to the following key areas:

- Risk assessment.
- Crisis management and emergency planning.
- HSE motivators.
- Relevant and concerned authorities’ source.

5.3.2 Surveillance aspect

This is based on the review to evaluate the extent to which oil companies are vigilant and involved in continuously monitoring of early warnings, alerts and identifying the alarming signals from potential incidents and accidents. It depends upon how proactive they are in receiving these messages, signals, understanding them and acting upon them.

This involves following areas concerning health, safety and environment monitoring for continuous improvement:

5.3.2.1 Health monitoring:

This includes answer of questions like what precautions are there for monitoring the health of employees systems and what analyses and corrective actions are carried out as a result. This includes the monitoring of:

- Sickness Records.
- Health incidents.
- Regular check-ups.

5.3.2.2 Safety and environment monitoring:

What systems are in place to monitor safety and environment risk including exposure to hazardous substances, emissions of GHG and what analyses and corrective actions are carried out as a result, including the monitoring of.

- Exposure.
- Safety incidents.
- Safety reports.
- Environment pollution.
- Waste generation, treatment, transportation and disposal.

5.3.2.3 Continuous improvements

This is based on understanding and answers to questions concerning what systems are in place to continuously improve the process of early detection of warning, rehearsals and alert messages using a variety of means including.

- Recent developments in the ICT communication field.
- Industrial and professional advice where relevant.
- Return to work programmed.
- Identify adverse trends.
- Monitoring records.
- Checking sickness records.
- Symptom reporting.

5.3.3 Response aspect

This aspect relates to actions by focusing on how well company have responded to HSE protection incidents taking into account internal and external rules, laws, norms and regulations. This includes four key areas as discussed below.

5.3.3.1 The HSE strategy

What is the strategy for HSE? Does it articulate clearly the requirements of every category of staff in the company? Is the strategy appropriate in terms of.

- The overall protection vis-à-vis health safety security and environmental protection.
- The planned incident response.
- The resources available, including all staff.

5.3.3.2 Incident responses

By answering questions like what does the evidence (derived from scrutiny of materials, observations, staff questionnaires and meetings with staff) reveal about the strengths weaknesses opportunity and threats identified in relation to:

- The nature and quality of response.
- Nature of communication, command and control during the incident predicator and post disaster situations.

5.3.3.3 Incident investigation

This involves answering questions concerning systems in place to properly investigate the response after the incident. It also helps in responding:

- What structured methodology framework for incident management is included during, before, and after disaster phases?
- How and under what circumstances the incident happen in the first place by what if scenario?
- What are the immediate and future impacts including consequences?
- What are the alternative options and opportunities for rescue, relief and recovery?

5.3.3.4 Lessons learned and feed back

To what extent are lessons learned captured, disseminated and implemented including:

- A system for recording and reporting lessons learned.
- A system for effective communication and disseminating lessons learned.
- A system for checking and getting feedback that includes check list on the lessons to be learned.

The areas in this aspect if tracked back indicates the following performance indicators that are identified from the literary and empirical research.

- HSE routine and periodic meetings.
- Alert messages warnings and bulletins.
- Team observations.
- Knowledge exercises.
- Learning new lessons from others and with others.

5.3.4 Achievements aspect

This aspect is related, concerned and focuses on the “hard evidence” in terms of key achievements that reflect how well the HSE standard is in action at the company.

This aspect covers the following two main areas as below.

5.3.4.1 Key performance goals (KPG)

This includes answers to questions like: What targets have been set by the oil and gas companies to monitor HSE protection management including:

- Accident type, nature, extent and severity rates.
- Incident rates.
- Lost Work Days.
- Insurance Costs.
- Stakeholders and Staff complaints.
- Non compliances with given standards.

5.3.4.2 Key performance indicators (KPI)

This includes understanding of answers to questions like how close are the KPIs to the stated KPGs in terms of what corrective actions plans were set to resolve the problem?

The areas in this aspect are tracked and found to be linked to the following performance indicators identified in the literary and empirical research.

- Manage HSE performance.
- Evaluate HSE performance.
- Workplace analysis.
- Accident investigation.

5.3.5 Resources aspect

Reviewers gather evidence through direct examination of all HSE resources available at the oil sector related companies. Reviewers would normally visit all the facilities within oil sector related companies, and do observe staff at all levels of the company in the course of normal duties. In evaluating the quality of HSE resources, reviewers' direct observations of facilities are considered alongside evidence from written documentation, meetings with relevant staff, and meetings with stakeholders.

This aspect covers the following main six areas:

5.3.5.1 Resources strategy

This is evolved after finding answers to questions like: Is there an appropriate overall strategy for resources? Are there effective arrangements for maintaining, replacing and updating resources, including internal and external liaison and coordination where necessary? Is the resources strategy consistent with?

- Support for the oil sector industry.
- The incident response strategy.
- The needs implied by the staff profile and the working environment?

5.3.5.2 HSE Manuals

Are the HSE Manuals available, accessible and appropriate in terms of:

- The requirements of incident response.
- The standard operating procedures.
- Specialist areas.
- Maintenance for safety critical equipment and devices.

5.3.5.3 The working environment

Is the working environment available and appropriate in terms of?

- The range and layout of the company or the oil field.

- Safety distances and space for work.
- Social, dining and recreational facilities.

5.3.5.4 Training of staff

Is all staff adequately trained with regards to HSE taking into consideration:

- Revision of the HSE strategy.
- Identification and implementation of action points required to meet the strategy more fully.
- Identification of internal indicators/measures of effectiveness.
- Plans for future enhancement.
- Training needs.
- Training materials.
- Training programmers.
- Training reviews.

5.3.5.5 Technical support

Is appropriate technical support available for support review?

The health and safety resources aspect includes the following indicators:

- HSE manuals.
- Equipment and information technology.
- Environmental.
- Training, Learner files Induction, Seminars, and Budgets for training.
- Lighting, Temperature Humidity Ventilation Noise.
- Dissemination of good practice.

5.3.6 HSE management and enhancement aspect

This aspect focuses on HSE management i.e. how the process is managed “now”, and HSE Enhancement i.e. how it will be continuously improved in the future. This aspect covers the two areas as follows.

5.3.6.1 HSE management

How effective are the internal arrangements for monitoring and evaluating the current HSE system? What HSE policy exists and to what extent does it cover all aspects relating to HSE. Do these arrangements involve appropriate consideration of?

- Appropriate management structures.
- Appropriate budgets.
- Appropriate plans.
- Internal monitoring data.
- External reports.
- The views of staff.
- The views of contractors and visitors.
- The views of employers and professional bodies, where appropriate.
- Other internal or external reviews.
- Staff development needs.

5.3.6.2 HSE enhancement

This includes the following issues:

What have been the significant outcomes of the HSE management process in terms of?

- Revision of the HSE strategy.
- Induction arrangements for new staff.
- Appraisal of staff in terms of HSE issues.
- Take up and application of staff development activities related to HSE.

How effective are the processes of self-evaluation and continuous improvement, including:

- The quality of the self-assessment.
- The use of management information.

5.3.6.3 Consultative process

This aspect can be tracked to the following performance indicators identified from the literary and empirical research:

- Implement management standards. management
- Enhance safety in workplace.
- Effective management framework.
- Promotion of HSE activities and external reports.
- Reports of professional/validating bodies, where appropriate.
- Meetings Staff with questionnaires.
- Action plans (including. prioritisation and timescales).
- Minutes of regular meetings including aspects of HSE.

5.4 The self-assessment document

The self-assessment document is the company evaluation the HSE management system in respect of compliance with the HSE requirements and employee's achievement measured against its own HSE standards.

The self-assessment document needs to include a clear description and evaluation of systems and procedures put in place to manage all aspects of HSE. The evaluation is organised commensurate with the structured six HSE aspects, and should be supported by clear evidence.

The self-assessment document should discuss both strengths and weakness in the oil and gas company. Where weaknesses are disclosed, the self-assessment document should include discussions of actions undertaken to reduce the severity and likelihood of the identified HSE matters in the work place.

5.4.1 Use of the self-assessment document

The self-assessment document informs and shapes the activities of the review team during the HSE review visit. Reviewers test the accuracy of the self-assessment document and the extent to which it presents an accurate picture of the HSE achievement in the oil and gas company under consideration.

The final report should have a judgement on the accuracy and openness of the self-assessment undertaken, and the steps taken to improve HSE performance of the company.

5.4.2 Structure of the self-assessment document

The self-assessment document includes two sections:

1. HSE Framework.
2. Evaluation of HSE achievement.

5.4.2.1 HSE framework

The framework includes statement(s) of the company HSE standards for the oil and gas company, together with a description of the systems and procedures in respect of HSE management and enhancement. The self-assessment document should also provide a breakdown of key company functions and departments to facilitate the review process.

5.4.2.2 Evaluation of HSE achievement

This section should contain the company's evaluation, with supporting evidence, of the HSE achievement, measured against the stated HSE standards. The evaluation should be set out in the structure provided by six HSE aspects.

- Prevention.
- Surveillance.
- Response.
- Achievement.
- Resources.
- HSE management and enhancement.

To facilitate this process, an aide-memoire has been developed for each of the six aspects with the view to providing a set of prompts designed to ensure focused coverage of each aspect. The HSE standards and the self-assessment form the framework for review.

5.5 Aide-memoire for the six review aspects

Aide-memoire is a “memory function.” Of HSE risk assessments for low frequency, high potential incidents (fatalities) in oil and gas industry. It needs to be done on the basis of collective industry experience. With the great crew-change that is occurring today, to an extent this memory is being lost. To help address this situation, the (OGP, 2009) Geophysical HSE Subcommittee assembled a simple database of fatalities from geophysical operations that have previously occurred. This improves the Oil and Gas industries’ HSE management and serves to:

- Provide essential training material for the new generation of professionals.
  - Knowledge of what has gone wrong in the past.
  - Avoid re-inventing of the wheel the hard way.
- Help answer the question: “Has this happened before?”
- Provide completeness checks on hazard registers and HSE guidelines and manuals.
- Provide further statistical insight on the risk pattern and profile
- Enable the use of the full industry experience, rather than the limited experience of a single company or individual.

A brief aide-memoire has been developed for each of the six aspects as shown below.

5.5.1 Aide-memoire: Prevention

The minimal list of “Prevention” questions, which needs to be explored, is shown in Table 5.2.

Prevention Questions	**Y**	**N**	**NA**	**Suggested Evidence/Examples**	**Action Needed (for N or NA responses)**
Are the formal mechanisms to ensure HSE systems and procedures reviewed regularly?				Internal audit plan/audit trial, annual 'rolling' programme of reviews	
Does the HSE policy contain a written statement of commitment to HSE?				Statement of Intent	
Does the policy include the arrangements for HSE?				Risk assessment records, consultation with employees, safe plant and equipment, safe handling, training, supervision, etc.	
Is there a mechanism to report HSE issues for inclusion in the review process?				Minutes of meetings, suggestion box, ISO 9000, TQM etc.	
Is there a system in place to identify training needs?				Job descriptions, staff appraisal system, induction, risk assessment etc.	
Are risk assessments regularly undertaken?				Risk assessment records, control measures, safe systems of work	
Has a risk assessment in connection with fire risk been undertaken?				Fire risk assessment record	
Are risk assessments regularly reviewed				Review records, evidence of review on risk assessment records	

Table 5.2: Aide-memoire: Prevention

5.5.2 Aide-memoire: Surveillance

The minimal list of "Surveillance" questions, which needs to be explored with the company, is shown in Table 5.3.

Surveillance Questions	**Y**	**N**	**NA**	**Suggested Evidence/Examples**
Are the relevant hazardous substances' regulations, codes and guidelines consulted and followed?				Monitoring Records
Are the HSE surveillance procedures developed in consultation with employer and employees?				Monitoring Records
Are examination and testing procedures used for HSE surveillance appropriate and adequate?				Monitoring Records
Is interpretation of individual test results based on HSE surveillance Guidelines?				Monitoring Records
Are discussions undertaken with a learner and the learner's supervisor?				Surveillance of learner and supervisor on the monitoring record assessment etc
Is communication with employer and employees concerning HSE surveillance demonstrated?				Monitoring Records

Table 5.3: Aide-memoire: Surveillance

5.5.3 Aide-memoire: Response

The minimal list of "Response" questions, which needs to be explored with the company, is shown in Table 5.4.

Response Questions	Y	N	NA	Suggested Evidence/Examples	Action Needed (for N or NA responses)
Have responsibilities for HSE been allocated to a named employee? Are they clear on what they have to do and are they held accountable?				Company charts, job descriptions, what you should know poster, etc.	
Are Staff consulted and/or involved effectively?				Training safety group membership, professional body etc.	
Does Staff have sufficient information about the risks they run and associated preventive measures?				Monitoring supervision etc.	
Are there right levels of expertise? Are employees property trained?				Training safety group membership, professional body etc.	
Is specialist advice from outside the company sought where appropriate? What arrangements are there for obtaining specialist advice?				Industrial experience, formal HSE qualifications, IOSH/NESBOSH qualified etc.	

Table 5.4: Aide-memoire: Response

5.5.4 Aide-memoire: Achievements

The minimal list of "Achievements" questions, which needs to explored shown in Table 5.5.

Achievements Questions	Y	N	NA	Suggested Evidence/Examples	Action Needed (for N or NA responses)
Are HSE matters well-communicated at all levels of the organisation?				Staff briefings, instructions, storage and maintenance	
Are conditions analysed to identify and eliminate existing or potential hazards?				Action Plan	
Is the work evaluated on the basis of accurate job descriptions?				Staff training records, job descriptions, etc.	
Is there a mechanism to ensure correct use, storage and replacement of PPE?				Staff briefings, instructions, storage and maintenance	
Is there evidence in respect of employee HSE training?				Instruction records, learners files etc.	
Is staff performance recognised and rewarded?				Staff training records, job descriptions, etc.	

Table 5.5: Aide-memoire: Achievements

5.5.5 Aide-memoire: Resources

The minimal list of "Resources" questions, which needs to be explored is shown in Table 5.6.

Resources Questions	Y	N	NA	Suggested Evidence and Examples	Action Needed (for N or NA responses)
Does the company assign special recourses to HSE on an annual basis?				Workplace specific HSE information etc.	
What kind of HSE collateral does the company have?				HSE booklets, Provider's own HSE information	
Is the appropriate HSE information well-disseminated to employees?				Instruction records, loaners files etc.	
Does the company have a procedure to ensure current legislative requirements are known?				HSE booklets, Provider's own HSE information	
Do the managers inform employees on the use of resources information management systems?				Instruction records, learners files etc.	
Is HR performance recognised and rewarded?				Provider's own HSE information	

Table 5.6: Aide-memoire: Resources

5.5.6 Aide-memoire: HSE management and enhancement

The minimal list of "HSE management and enhancement" questions, which needs to be explored in the standard IAGC format as per 2011. Update IAGC Aide Memoir User Manual with the case study company, is shown in Table 5.7.

HSE M/E Questions	Y	N	NA	Suggested Evidence and Examples	Action Needed (for N or NA responses)
Is there a formal mechanism for testing the evaluation of conclusion plans?				Questionnaires, quizzes etc.	
Are there systems in place to ensure action/control measures identified and taken where required?				Action plans (incl. prioritization and timescales), inspection etc.	
Is there a mechanism to update HSE management guidelines?				Changes in prohibitions, activities on-going training / etc.	
Are there systems in place to improve HSE performance?				HSE booklets, Provider's own HSE information	
Is staff performance recognised and rewarded?				HSE booklets, Provider's own HSE information, Workplace-specific HSE information etc.	

Table 5.7: Aide-memoire: HSE Management and Enhancement

5.6 Process of HSE performance review methodology

Based on literature review of the models and tools for HSE risk assessment (OGP, 2009) the methodology of the health safety and environment management performance review is developed and apply to the data collected of case study companies.

The Review Method which is conducted by the Quality Assurance Agency for Higher Education (QAA) to describe the method and procedures for carrying out subject reviews in England and Northern Ireland during 2000 and 2001, and the Health Safety and environment Performance Measurement Tool prepared by (Amey Vectra for Health and Safety Executive, 2000) were taken as the basis for the process of the review methodology proposed in this research. It identifies the major drawbacks of every model in the literature described earlier in the previous chapter. This method model is customised to fit the needs of the oil sector related companies in Libya by incorporating those HSE aspects considered critical for the oil companies identified in empirical research work. These, put together formed the basis of the process of our proposed health safety and environment management performance review methodology for oil sector related companies in Libya.

5.6.1 Overview of the HSE review methodology process

An overview of the review methodology process for the oil sector related companies in Libya is shown in Figure 5.5 below.

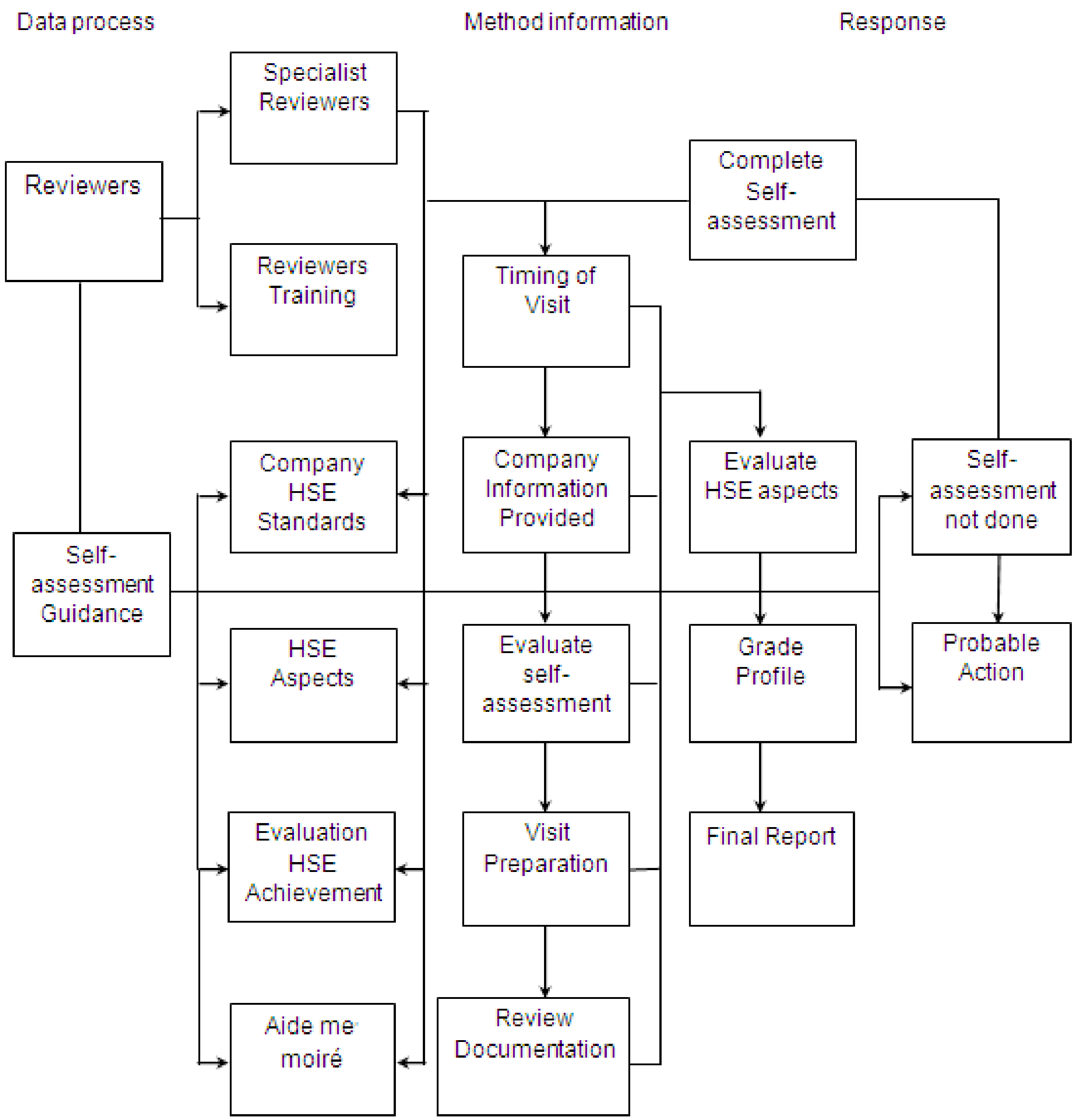


Figure 5.5: HSE Review Methodology Process

5.6.2 Initial data process

Once to be able to do the review, the following initial data processes are essential:

5.6.2.1 Self-assessment

A self-assessment is the initial process in applying this method. Consequently, the self-assessment needs to include a clear statement of company HSE standards, an aide me' moiré outlining the areas that the reviewer needs to address, and a clear evaluation and description of the safety systems programmes designed to meet them.

The evaluation is organised within the structure given by the aspects of HSE, and should be supported by evidence. More details about health safety and environment management self-assessment can be found in 5.4.2.

5.6.2.2 Specialist reviewers

The need external specialist reviewers who have long experience of relevant professional or occupational practice, and a review coordinator who leads reviews and has extensive experience, usually gained by working with such procedures is identified.

Specialist reviewers are trained to ensure that they are capable of carrying out their duties effectively.

5.6.2.3 Review method process

A review method process diagram provides a suggested process to apply the review methodology. It is assumed that if self-assessments have not been completed, this will be the immediate course of action for the company before the review method can be applied.

Once the initial process information has been collected, the various reviews should be completed. Following this, the findings, graded profiles, and the overall summative judgment should be developed.

5.6.2.4 Response to non-compliance

Writing of the self-assessment is the initial process in applying this method. Therefore the fact that the company has not conducted a self-assessment will immediately exclude it from applying the method at that time, and will require the first action to be completion of required self-assessments. The fact that self-assessment is a legal requirement may lead to an enforcement action by the reviewer.

5.7 Overall description of HSE performance review methodology

The target of the review methodology evolved in this research is to describe the method and procedures for carrying out reviews to evaluate the effectiveness of health safety and environment management performance in the oil sector related companies in Libya. It is designed to focus at the level of HSE protection management achievements, and it describes for reviewers, companies, and others the protocols, procedures and practical organisation of reviews from advance planning through to the preparation of reports.

5.7.1 The six HSE review aspects

HSE aspects of the review methodology are designed to help provide a common structure for each stage of the review process. The aspects of the review methodology should be sufficiently broad and inclusive to enable the reviewer to give full weight to the particular features of the oil sector related companies and different contexts.

5.7.2 The features of the performance review methodology

As stated in the earlier sections 5.1.1, this review methodology is similar to that developed by the (QAA, 2000-2001). However, this new method is produced independently, and its goal is to describe the method and procedures for carrying out reviews to evaluate the effectiveness of health safety and environment management performance. It is focused at the level of health safety and environment management achievements in the oil and gas sector related to oil and gas industry in Libya and it describes for reviewers the protocols, procedures and practical organisation of reviews from advance planning through to the preparation of reports.

The following are the main features of the review methodology:

- HSE policy and long strategy.

- Peer review visit.
- Self-assessment.

5.7.3 Preparation for the review visit

The preparation of the visit should be under a good co-operation between the team and the company, and may be divided in the three following stages:

- Analysis of the self –assessment.
- Reviewers.
- Preparatory meeting (company and review team).

5.7.4 Review visit

The purpose of the review visit is to enable the reviewers to review, consider and test the evidence of the effectiveness of health safety and environment management performance, in the light of the oil sector related companies HSE protection standards and review methodology aspects, and to establish a graded profile and an overall judgment on the effectiveness of health safety and environment performance.

5.7.5 Review report and findings

After each review visit, a final review report and findings will be presented, and include:

- Review reports.
- Overview findings.
- Process of review methodology.

5.7.6 Peer reviewers

Reviews should be carried out by a specialist team of registered professionals and with good experience in dealing with HSE matters, led by the review chair. It is the main responsibility of the team and the review chair to review evidence and to make judgments on the effectiveness of health and safety environment performance provided by the companies.

For the proposed review methodology, the selection of peer reviewers is believed to be fair, because the reviewers have knowledge, experience, and skills in health safety and environment within Libyan cultural context. The reviewer's assessments as far as possible are confidential, sufficiently unbiased, free, fair and independent. Moreover, they do not have any conflicting financial or other interest that could impair their objectivity or create an unfair competitive advantage.

5.7.7 Self -assessment document

The self-assessment is designed to present the HSE standards of the case study oil companies, and provides an evaluation of the health safety and environment achievements. The evaluation is organised within the structure given by the HSE protection aspects of companies. It needs to be supported by evidence. A self-assessment is intended to discuss both strengths and weaknesses in the oil companies. Where weaknesses are acknowledged, the provider is encouraged to discuss the issues and the steps taken to improve health safety and environment. The self–assessment pack is proposed for the oil sector related companies. It is designed to present an accurate picture of the health safety and environment management achievements in the companies. It includes cultural, social, and economic factors. It is also reviewed, and pretested prior to administration, for eliminating errors.

5.8 Review against HSE standards

The statement of the health safety and environment standards included in the self - assessment provides a reference point for the review. The statement should be sufficiently clear to enable a review visit to be planned and undertaken.

A reviewer evaluates whether the HSE aspects are put into effect without weaknesses or deficiencies, and also evaluates the levels of performance, whether the standards set, exceeded (above the required levels of performance), met (achieving the required levels of performance), almost met (no major deficiencies and required levels of performance seems achievable without extensive extra activity), or not met (significant action is needed to achieve the required levels of performance).

HSE aspects provide a common structure for each stage of the review process: the self-assessment, review visit, the judgments, and the review report. Six most important aspects are identified according to the critical indicators which may be fruitful for HSE authorities and others to use in motivating the target groups. It is intended that the HSE aspects is sufficiently broad and inclusive to enable the reviewer to give full weight to the particular features of the company in different contexts.

5.8.1 During the review visit

A goal of the review visit is to inspect, consider and test the evidence of the effectiveness of health safety and environment management performance, in the light of the health safety and environment policy and strategy, and to establish a graded profile and an overall judgment on the health safety and environment management of those companies.

5.8.2 Immediately after the visit

The graded profile is intended to show the extent to which the health safety and environment management achievement demonstrates that the standards set by the companies are being met. Applying a grade to each of the HSE aspects creates the profile. The assignment of grades is a matter for the professional judgment of the reviewer, drawing on evidence from both the self-assessment and the review visit.

5.8.3 Overall summative judgment after the visit

An overall summative judgment is derived from the profile. Each HSE aspect has equal weight. The reviewer gives the judgments to the company in an oral feedback at the end of the review visit.

5.9 Arrangement for review visit

The arrangement for the review visit is divided into four stages: advance planning and self-assessment by the company analysis of the self-assessment; the reviewers and the preparatory meeting (with the company, and by the review team). The arrangement for review is most effective when they are undertaken with full cooperation between the company and the review team.

5.9.1 Advance planning for the self-assessment document

The review chair, in conjunction with the company, undertakes advance planning. The precise timing of review visits is a matter for discussion and agreement between the oil companies and the researcher. Each company completes an information form for each unit of review in which it has provision to include information on the size, scope and nature of the provision to be reviewed, and the company's preferred dates for the review visit. This advance information provides a basis for further discussions with companies to plan and agree the timing of individual visits, and informs the reviewer.

5.9.2 Analysis of self-assessment

The self-assessment provides the basis for reviewers to set the priorities and programme for the review visit. The reviewers check the self-assessment for each company. The main functions are to ensure that the HSE standards are clear and that the document complies with the specified length and structure.

5.9.2.1 Programme of review Visit

The program is agreed at the preparatory meeting and should be included in the advance documentation which the company sent to the reviewers.

The activities, which should be carried out by a review team during the visit as below:

- Scrutiny of company documentation reviews and reports.
- Observation of the various forms of workplace culture and safety behaviour being carried out during the review visit.
- Meetings with supervisors and HSE managers.
- Meetings, where appropriate, with all the staff.
- Consideration of the learning resources.
- Meeting of the review team to consider the evidence, share information, and form judgments.

The review chair maintains an overview of the range and balance of review activities, and guides specialist reviewers in apportioning their time. It is essential that the overall range and balance of activities enable the team to develop a forceful evidence base for the judgments to be made in relation to each of the six HSE aspects of the company. Specialist reviewers are expected to arrange and agree individual timetables with a view to achieving this evidence base.

On arrival day at the company, the review team meets before being introduced to the MD of the company or other senior representatives. At this meeting, it can be helpful if the company facilitator informs reviewers of any matters, from the institutional perspective, which may be important to their understanding of the activities as stated before being reviewed. An initial meeting on the first afternoon of the visit allows an opportunity for the company representatives to make a brief presentation on the provision to be reviewed, and to inform reviewers of any developments since the self-assessment was undertaken. The meeting with company representative also provides an opportunity for the review chair to remind team members present of the afore mentioned activities review method and its protocols.

The review visit programme includes a range of meetings between members of the company and the reviewers to consider the various aspects of the company. Throughout the visit, the review team meets daily to discuss its program and its findings. The company facilitator is an observer at most meetings, and may provide factual information relevant to the team's discussions. However, the company facilitator may not attend team meetings or parts of meetings which involve direct discussion of grades, such as the final meeting.

5.9.3 Review team

The team is responsible for coordinating and managing the review visit, and for ensuring that it is conducted within the research guidelines. This involves preparing for the review visit in cooperation with the company coordinating the work of the review visit; ensuring that evidence is inspected and tested, and that the judgments reached are forceful; providing oral feedback to the company at the end of the visit; and preparing the review report after the visit.

A high responsibility of the specialist reviewers include analysing the self-assessment and other documentation provided in advance of the visit; participating in the review visit to review, share and test evidence; making judgments on the HSE performance; and commenting on the draft review report after the visit.

5.9.4 Preparatory meetings

The review chair arranges a preparatory meeting with the company held before the review visit. The goal of the preparatory meeting is to discuss.

- Any necessary clarification of the self-assessment.
- Means of securing a representative sample of the company, particularly in complex reviews.
- Scope and nature of the company to be reviewed.
- Role of institutional facilitator, where relevant.
- Range of health safety and environment work available for scrutiny, and the extent to which this constitutes a representative sample of HSE achievement.
- Documentation to be sent to the review chair prior to the review visit, and the timetable for its receipt.
- Meetings to be arranged in advance for the next visit.

The companies send the self-assessment and other advance documentation to the review chair before the review visit. Any other communication between the review chair and the company, before or after the review visit, is channelled through the review chair.

Also, the review chair contacts the specialist reviewers to discuss arrangements for the visit and to agree on the responsibilities within the team. Specialist reviewers normally assume responsibility for coordinating and sharing evidence relating to one or more aspects of the company. The review chair provides a written briefing for all team members at least a week before the visit.

Prior to the visit, specialist reviewers are asked to produce a brief written commentary on assigned aspects, based on the self-assessment and the other advance documentation. In producing this commentary, reviewers are required to refer to the questions in the review method aide me' moiré. The commentary is to make full reference to the HSE standards, and identify matters on which further evidence is required. Reviewers' commentaries are discussed at the first review team meeting; they inform the team's priorities and the balance of activities undertaken during the review visit.

5.9.5 Review visits

The review visit should be conducted in good cooperation between the company and the review team. The purpose of the review visit is to review, consider and test the evidence of the effectiveness of HSE management performance, in the light of the company health and safety standards and HSE aspects, and to establish a graded profile and overall judgements on the effectiveness of health safety and environment performance. Each visit is for 3 days, starting on Sunday morning and ending on Tuesday afternoon.

5.10 Issues to consider during the review visits

In reviewing evidence, reviewers should refer to the review aide me' moiré. All reviewers are expected to identify, share, consider and evaluate evidence related to all HSE aspects of the company. Reviewers make notes of meetings with supervisors and employees regarding the effectiveness of HSE aspects in employees' work. The collation and circulation of notes within the review team assist in developing a collective evidence base for the judgements made. Reviewers refer to these notes in preparing written evaluations of the effectiveness HSE aspects; the review chair retains the notes at the end of the visit.

The following key questions should be tested:

- Are the HSE aspects put into effect without weaknesses or deficiencies?
- Do the HSE standards set by the company and the level of performance exceeded, met, almost met, or not met?

- How are the rules and modes of action taken to improve the HSE activities?

5.10.1 Observation of HSE issues

The arrangements for the review during the visit should reflect the nature of the company and normally include observations of Health safety and environment issues. The purpose is to obtain a collective view of the health safety and environment management achievements, and to add to the overall understanding of the effectiveness of health safety and environment management performance. Reviewers are required to observe a reasonably representative range of HSE issues. In order to achieve effective observations, the review chair prepares a Preliminary schedule of observations for discussion with the review team.

The reviewer is required to meet the member of staff responsible for HSE management in a company before review commences in order to introduce himself, and to discuss the overall objectives of the activity.

After attending a session, the reviewer offers a brief oral feedback to the member of staff, even if this includes a later appointment being made to provide feedback. This oral feedback is confidential to the member of staff, and is always given privately. The aim of the feedback is to offer constructive comment on the observations made, rather than to prescribe preferred practice. Reviewers must preserve the anonymity of staff in all written reports and in discussions with other members of the company, Table 5.8 below is used as a form for that.

Company	**Activities**	**HSE issues**
Reviewer	Date	Observations
Objectives planned (better knowledge, better understanding, increased key skills, and …)		

Please comment on strengths and weaknesses of the company in relation to the objectives planned:

Prompts	Strengths	Weaknesses
Clarity of objectives Planning and company Methods/approach Content (currency, accuracy, relevance, use of examples) Employees participation Use of resources		

Please indicate relevance to the six HSE aspects:

Prevention and awareness	Surveillance	Learning and communications	Performance achievement	Resources	Management and enhancement

Table 5.8: Standard Reviewers Observation Note During Visit

5.10.2 Checking of resources

Reviewers also reviewed evidence through direct examination of the HSE resources. They visited the facilities and observed staff and employees using HSE resources and their equipment and tools for associated activities. In evaluating the efficacy of HSE resources, reviewers' direct observations of facilities are considered in addition to evidence from work place, written documentations and procedures, meetings with relevant staff where it was felt necessary. The end result of our review was based on our effective evaluation of HSE resources.

5.10.3 Scrutiny of documentation

Reviewers are also required to review evidence through scrutiny of HSE documentation in respect of oil and gas case study companies. The evidence base drawn on includes reports and advice from specialist external sources, employers and validating and accrediting bodies, as well as internal documents and reports. Emerging judgments are refined and tested against as wide a range of evidence as possible; for example, views expressed in meetings by employers or employees are checked and tested against the documentation provided.

5.11 Making overall judgments

The evidence inspected and considered by the whole review team informs the reviewers' collective judgments on the effectiveness of HSE management performance in relation to each aspect of HSE. In each case, judgments are based on the principle of fitness for purpose in relation to the stated policy and strategy, and the extent to which this is being met. Grades are assigned by the whole review team, on the basis of the evidence inspected in relation to each aspect of HSE, and using the criteria for assigning grades. All team members are expected to share information gathered which is relevant to any HSE aspect, but individual reviewers may coordinate the evidence related to particular aspects. Written summaries of the information and evidence inspected should be distributed continuously among the team, including notes of meetings and completed observations and employees' work/assessment notes. The judgments are given in an oral feedback from the review team to the company at the close of the review visit.

5.11.1 Review team meetings

The review team meets daily to discuss its findings, normally at the end of the working day. Team meetings are used to review the evidence inspected in relation to each HSE aspect, to form preliminary judgments, and to determine which issues require further exploration. Reviewers are expected to evaluate how the evidence inspected compares with the self -assessment and the company policy and strategy, and to test the strength of evidence adduced to support judgments. The review team meeting on the penultimate day should allow sufficient time for a discussion of the evidence inspected in relation to each aspect of provision, and a preliminary discussion of grading. Discussion on the information inspected and emerging judgments should involve the whole team.

The reviewers hold a final meeting at end of the afternoon on the last day to review any additional evidence, to agree the outline of strengths and weaknesses in each HSE aspect, to finalize the grading for each aspect of HSE, and to determine the overall conclusions to be reported to the company. The company facilitator does not attend this meeting.

Table 5.9 below shows notes for meetings with employers and employees of the company aspects meeting, etc.

Please comment on strengths and weaknesses of assessment

Judgments	**Strengths**	**Weaknesses**
Design: Clarity of task Appropriateness to level Match to employees' profile Criteria: Appropriateness, clarity and implementation of judgment criteria grading: Consistency of marking Evidence of internal moderation Feedback: Quality of feedback		

Please summaries the overall effectiveness of assessment and judgments.

Please indicate relevance to the six HS E aspects:

Prevention and awareness	Surveillance	Learning and communications	Performance achievement	Resources	Management and enhancement

Table 5.9: Review Team Meeting Note

5.11.2 Written summaries

If the draft summaries written by reviewers during the visit focus on the evaluation of the evidence inspected in relation to each HSE aspect. Summaries should be analytical rather than descriptive, and make direct reference to relevant policy and strategy and to sources of information such as meetings, reports, documents, and observations. The written evaluation should summarize the relevant strengths and issues relating to each HSE aspect and, overall, should underpin the grade assigned.

5.11.3 Criteria for assigning the final judgments

If the first review, one or more of the profile aspects receives a grade of 1; the effectiveness of HSE management performance will be recorded as needing further review within a period of time. A review report containing this decision will be presented. A second review should take place within one year.

After this further review, the profile still contains one or more aspects graded 1, effectiveness of HSE management performance will be recorded as unsatisfactory. A second review report will be presented.

If the profile with all aspects graded 2 or better will be reported as approved. However: where the graded profile includes three or more grade 2s, the company will be requested to write an improvement plan.

5.11.4 Oral feedback meeting

The meeting with MD of the company at the end of the review visit is intended to provide oral feedback on the outcomes of the visit. The meeting is chaired by the review chair, who will convey the graded profile, the overall judgment, and the main evidence that will be included in the presented report. It is not a consultative meeting which might affect the judgment of the reviewers, although a limited amount of clarification by the reviewers and the company facilitator may take place.

5.11.5 Preliminary review report

The review chair presents the first complete draft of the report in the week immediately after the visit by drawing on the summaries prepared by the reviewers during the visit. This draft is sent to the reviewers, who then check to ensure that it is factually accurate, and that it represents the views of the review team. It is particularly important that reviewers return comments on the first draft of a report to the review chair within one week, in order that he may adhere to the production schedule for reports. The company is then invited to comment on any factual inaccuracies in the draft report.

5.11.6 Final review report and findings

The review report is presented after each review visit. The report includes a description of the review method; a statement prepared by the company on the HSE policy and strategy being reviewed; the graded profile and the overall judgment on the health safety and environment management performance of the company an evaluation of the HSE management performance, organised under the six HSE aspects; and the conclusions reached.

5.11.7 Presenting the judgment

The completion of the reviews for all the companies, the review chair (researcher) will write overview and findings that are designed to promote best practice and enhance quality.

Reviewers are invited to provide debriefing comments at the end of the programmed visits. These comments contribute to the overview findings. Each set of overview findings includes a list of providers in the HSE area, and the graded profiles achieved by these providers. Lists of the reviewers involved in the review visits are also included. Table 5.10 below shows the statement of the overview record of findings.

<table>
<tr><td colspan="3">Record keeping and findings</td></tr>
<tr><td colspan="3">Company</td></tr>
<tr><td colspan="3">Reviewer:</td></tr>
<tr><td colspan="3">Date:</td></tr>
<tr><td>HSE aspect:</td><td colspan="2">Grade points</td></tr>
<tr><td colspan="3">Evidence:</td></tr>
<tr><td>HSE aspect:</td><td colspan="2">Grade points</td></tr>
<tr><td colspan="3">Evidence:</td></tr>
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<tr><td>HSE aspect:</td><td colspan="2">Grade points</td></tr>
<tr><td colspan="3">Evidence:</td></tr>
<tr><td>HSE aspect:</td><td colspan="2">Grade points</td></tr>
<tr><td colspan="3">Evidence:</td></tr>
<tr><td rowspan="2">The effectiveness of health safety and environment management and level of achievements in the company is approved.</td><td>Yes</td><td>No</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="3">Comments / observations:</td></tr>
<tr><td colspan="3">Reviewer signature:</td></tr>
</table>

Table 5.10: Overview Record of Findings

5.12 Discussions

This chapter presents a structured health safety and environment management performance review methodology for oil sector related companies in Libya. The review methodology is primarily based on the findings of the literature review of the models and tools suggested to measure HSE protection management performance, and the six health safety and environment management aspects that are built according to the data collected from the Libya based oil sector related companies.

The chapter describes the method and procedures for carrying out reviews to evaluate the effectiveness of HSE performance. It describes for reviewers and companies protocols, procedures and practical organisation of reviews from advance planning through to the writing of reports.

The review methodology is applied to case study oil companies in Libya. It includes a careful planning for their successful execution, covering not only the usual subjects, but also contingencies, HSE preparedness, environmental and cultural sensitivity. It is achieved by close collaboration with local authorities like NOC and EGA to prevent impact on the environment and local subsistence lifestyles. Finally mapping of HSE is presented as a matrix (4x6x4x3=288) for actions at global, regional, national and local levels using six aspects, four problems that show at a glance HSE performance review findings from stage 1, stage 2 and stage 3. It gives a vision what is right for people for greater prosperity and justice by leaving behind inefficient technologies of another century and business models that are created by giving them an action plan to better life.

5.13 Summary

In summary, this chapter has explained the HSE aspects, including all the indicators in detail, and the processes gone through to develop a review methodology for the health safety and environment management performance depending on the six health safety and environment aspects which were the most critical to the Libyan oil sector related companies. It needs to be carefully considered to ensure successful validation of the review methodology presented.

Finally, the approach adopted for developing a structured health safety and environment management review methodology is detailed in the BS 8800 Guide to Occupational Health and Safety Management System, (ISO 14001 Environmental Management Standards, and HSG65 Successful Health and Safety Management). So, the methodology for the health safety and environment in this case is built around these existing guides, and the process of the review methodology itself is very similar to that of the Subject Review Method used by the (QAA) and later by Al-Qahtani to describe the method and procedures for carrying out subject reviews.

Chapter 6: VALIDATION OF THE HSE PERFORMANCE REVIEW METHODOLOGY

This chapter discusses the validation of the performance review methodology by direct application to five case studies in Libyan oil and gas industries. The validation is based on review visits based on the six HSE aspects described in the previous chapter. The review visits are conducted in a spirit of mutual trust and confidentiality by creating a congenial environment, through interview, stakeholders meetings, brain storming discussions and co-operation between the companies and members of the review team.

6.1 Case study companies

Five companies that are representative of both domestic and international oil and gas companies operating in Libya are chosen as possible case studies to validate the developed health safety and environment management performance review methodology. The sample companies used in the validation phase of the research is the same as the one described in Chapter 3.

The validation is based on considering and reviewing the evidence of the effectiveness of the companies' health safety and environment performance management based on the six HSE aspects. The outcome of the review is to establish a graded profile with an overall summative judgement.

The case studies include upstream (fields, production facilities and exploration potential), midstream: (pipelines, and terminals), and downstream (refineries and petrochemical plants. They have been chosen for the following reasons:

- They have both administrative office and field or work site staff.
- They have knowledgeable and insight into the management of HSE across the range of risk.

- They are familiar and have experience in incorporating HSE management systems.
- They have some good experience in dealing with similar research.

The exact details of the five companies reviewed are not given in this thesis due to confidentiality reasons. However, some details indicating their broad classification are given in Table 6.1.

	Company	**Business name**	**Address**	**Main activities**	**No of employees**
1	An Exploration and Production International oil and gas Company.	Exploration and production Company	Tripoli	All Exploration and Production (EP) Operations.	550
2	A Petrochemical Company	Petrochemical plant services	Abukamch	Exploration and Production Co	280
3	An Oil Services Company	Mud logging and Drilling Services Company	Tripoli	Exploration Services	95
4	A Refinery Company	Refining Company	Zawia	All refined products	950
5	A Drilling Mud Company	Drilling Mud's	Benghazi	All Drilling Mud Products.	500

Table 6.1: Five Case Studies Companies

6.2 Review group composition and training

The review team comprised of four to six Specialist Reviewers with experience of relevant professional or occupational practice, and a review coordinator who has sufficient experience to lead similar reviews groups and had proven capacity acquired or gained by working with such procedures (the researcher).

The review visits were conducted by voluntary group team members with academic background chosen after careful process based on their biographical check-ups and peer review. Finally the voluntary skilled and experienced team members with proven academic, professional and occupational practice are given in the (Table 6.2). Due to confidentiality reasons and cultural limitations their biographical details cannot be revealed since four of them belong to Public sector i.e. NOC, LNCSM and EGA Authorities and remaining two from private enterprises with health safety and environmental protection services.

Table 6.2 shows the composition of the review team in respect of professional affiliation and associated institution.

No.	**Position**	**Institution**
1	Safety manager	Civil Defence
2	Executive manager	Health Safety Environment and Fire Fighting Systems.
3	Technical manager	Safety Consulting
4	HSE and security manager	Refinery Emergency for Health Safety and Environment.
5	HSE manager	Oil Terminal Emergency for Health Safety and Environment.
6	HSE manager	Mud Plant Emergency for Health Safety and Environment.

Table 6.2: Composition of Review Team

6.2.1 Specialist reviewers qualification and experience

Each member of the specialist reviewers group has been chosen so as to have a track record of proven competence, knowledge and understanding of the review process, and they have the following experience:

- Commitment to HSE principles.
- Analytical competence and sound judgement.
- Personal authority and presence, coupled with the ability to act as an effective team member.

- Good time management skills.
- Experience of chairing meetings.
- Good standard of oral and written communication, preferably with experience of writing formal reports for Exploration and production and processing plant deadlines.

6.2.2 Reviewers induction and training

The specialist reviewers have been given an orientation and induction training to ensure that they are capable of carrying their duties effectively, and more particularly help them to:

- Read, understand and analyse the self-assessment document submitted by the oil and gas companies and any other documents sent in advance of a review.
- Adhere to the review group schedule agreed between the oil and gas companies and the review coordinator.
- Participate in visits to the oil and gas companies in order to collect, compile, gather, share, and test and verify evidence.
- Make judgements on the health safety and environment achievement.
- Contribute to, and comment on the compilation of the final report of the review.

6.3 Validation review visits programme

An outline of a mutually agreed programme has been prepared after detailed discussion with all the stakeholders. The programme of work was confirmed at the preparatory meeting and can be found in Figure 6.1. The review chair is expected to maintain an overview of the range and balance of review activities. This helps guide the specialist reviewers in apportioning their time to each of the six aspects.

The entire process is depicted in Figure 6.1 below.

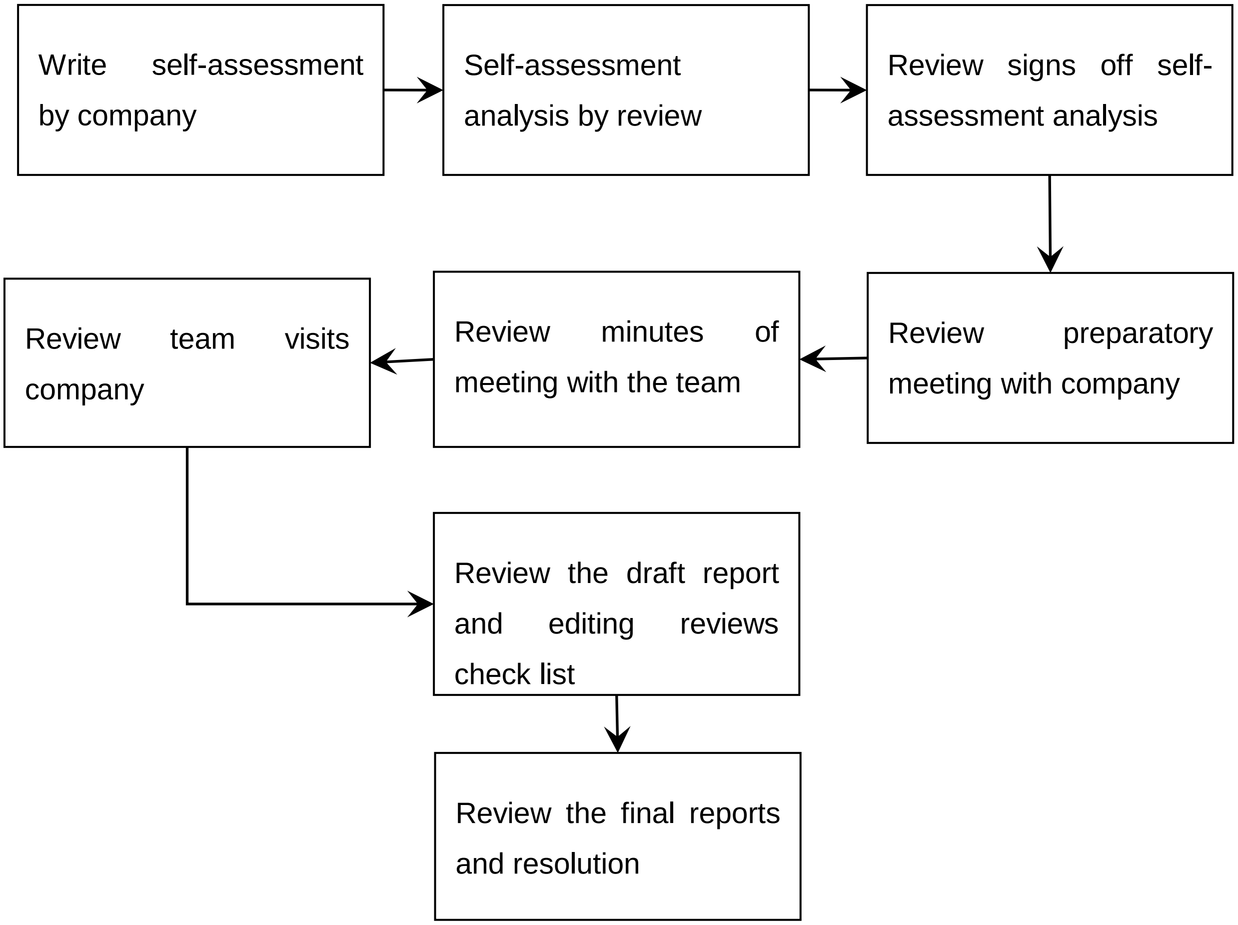

Figure 6.1: Procedure for Review Visit

6.4 Typical schedule of a validation review visit

Keeping in mind the working days and hours in Libya, each visit is planned so that it starts on Sunday morning and ends on Tuesday afternoon.

6.4.1 Day 1: Visiting and meetings

Morning:

- First private meeting of review group team members.
- Opening welcome from head of oil Company and/or his representative, briefing on contextual aspects of the company and its position in the market place.

- Initial meeting with the HSE manager (employees' representatives may also be present).
- Afternoon:
- Meeting between review team and company contact facilitator.
- Visit key facilities at Exploration and production location and observe HSE gadgets, devices, equipment, and employees' activities.
- Wash-up meeting of review group team, attended by company facilitator.

6.4.2 Day 2: Comprehensive reviews

Morning:

- Initial Meetings with company contact, HSE manager and other staff, and address various HSE issues, and related aspects.
- Reviewer's team collects and compiles evidence by situation assessment, probing and examining HSE resource facilities, and reviews documentation provided. After brain storming session, evidence is shared continuously and evaluated in relation to the aim and objectives.
- Individual reviewers begin to prepare their individual written summaries.

Afternoon:

- Holding stakeholder meeting in presence of HSE manager and other related staff to enable reviewers and staff to clarify any points that have arisen during the review visit.
- Organize meetings with company, HSE manager and other staff, and address various HSE aspects.
- Reviewer's team members observe issues to gather evidence by examining HSE resource facilities. They review documentation provided. Observations, findings and evidence generated is shared continuously and evaluated in relation to the aims and objectives.
- Individual reviewers prepare and sum up their written summaries.
- Stakeholders meeting in presence of HSE manager and other staff to enable reviewers and staff to give explanation and clarify any points that might have arisen during the review visit.

- Closing Meeting of review team, in presence of facilitator.

6.4.3 Day 3: Judgment and oral feedback

Morning:

- Reviewers finalize their findings along with reasoning and supporting evidence. The process begins with generally carrying out a limited number of critical observations and continuing with the final evaluation of documentation.
- Holding final meeting of review team; prepare written summaries of evidence and judgements formally established (company facilitator may not attend).

Afternoon:

- Oral feedback is given to executive or head of company and supervisory staff.
- Company staff is not allowed at that stage to dispute any judgements. They are however allowed to seek clarification as opposed to appeal against any judgement and the Review Coordinator will respond formally stating the evidence collected during the review visit.

6.5 Validation of case studies

This chapter presents the findings of five review visits conducted using the HSE performance review methodology. It also includes results as outcomes, outputs, indicators, targets and recommendations.

The review tasks carried out by the review group team members include the following:

- Review documentation, processes, procedures and reports.
- Observation of the various forms of workplace culture HSE protection behaviour being carried out.
- Hold Meetings with supervisors and with HSE protection managers.
- Organize meetings, where appropriate, with all stakeholders including both employers and employees.
- Consideration of HSE protection resources.

- Consideration of each of the six aspects in isolation and in combinations so as to assess the whole life cycle of HSE in the company.

Each case study is briefly described in the next sections with an attempt made to present the key findings and associated judgements an organised way. A template based on a tabular form has been created to capture such key findings and is shown in the next sections for each review visit made.

6.6 Case study No.1: An international exploration and production oil and gas company

An international exploration and production oil and gas company are engaged in finding petroleum in Sirte basin area. It has 550 employees, and the main activity is to explore oil and gas using advanced drilling technologies.

The target data received from this oil company indicate its strategy and plan of action as provided by the company itself. The critical overview of the company health safety environmental protection policies, strategies and plan of action are presented in the sections below.

6.6.1 Company HSE standards

Key data derived from the documentation received from the company in respect of HSE standards is summarised below:

- Considers and communicates potential risks to HSE when performing daily work duties.
- Carries out a training needs analysis based on business risk profile and risk registers
- Tailors specific programmes to all categories of employees, making the learning and control measures relevant to people.
- Tailors health surveillance and other controls to fit business risk profile.
- Establishes robust emergency plans and implements drills.

- Participates in sharing information with like industries through trade associations.
- Creates and sustains a work environment that is healthy and safe for all employees.
- Establishes a good understanding of the potential health safety and environment risks within the general business.

6.6.2 Overview of findings

Key findings of the specialist reviewers based on the six HSE aspects are given in Table 6.3.

Record keeping and findings	
Company: An Exploration and Production International oil and gas Company Ltd.	
Reviewer:	
Date:	
HSE aspect: Prevention	Grade points: 2
Evidence: • Awareness of hazards acceptable. • Little evidence of thorough and systematic approach to drive the awareness through risk assessment to rigorous risk control measures (Risk assessment records) • Health safety and environment policy does not contain written statement of commitment to HSE • No system in place to identify training needs. • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.	
HSE aspect: Surveillance	Grade points: 2
Evidence: • No evidence of any systemic effort to ensure that the examination and testing procedures used for HSE surveillance appropriate and adequate. • Communication between stakeholders including employer and employees concerning health safety and environment surveillance seems good. • Starting to think about formal monitoring of housekeeping just introduced. • Workforce can make complaints to line manager, in hazards booklet. • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.	
HSE aspect: Response	Grade points: 3

Evidence: • Company has allocated safety representative responsible for the HSE matters. (company chart) • Booklet for employees to fill in if they spot any hazards (Hazard booklet). • All training is on the job with induction provided by HSE manager but thought that there was room for improvement. • Supervisor consulted and involves employees and representatives effectively. • There is system for recording lessons learned. • Achieving the required levels of performance, standard met.		
HSE aspect: Achievement	Grade points: 3	
Evidence: • Work evaluated on basis of accurate description (job description). • Analysis of all workplace conditions to identify and eliminate existing or potential hazards. • No accident for last 5 years (Accident records). • Team investigates each accident/near miss (Action plans) • Achieving the required levels of performance, standard met.		
HSE aspect: Resources	Grade points: 2	
Evidence: • Mechanism to ensure the correct use, storage and replacement of (PPE). • Company does not assign special resources to HSE activities on annual basis. • Some signs noise and necessary PPE. • Employees given instructions on how to fit PPE (but no training, except for those using powered breathing apparatus and helmets) • Difficulties in providing information for employees because many do not speak/read Arabic or English, and company not aware of what language they do speak. • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.		
HSE aspect: HSE management and enhancement	Grade points:3	
Evidence: • company has made contract with external provider to update HSE management guidelines and issues. • Mechanism to test enhancement of advanced evaluation of conclusion plans (Questionnaire). • Acceptable system in place to ensure action/control measures identified and taken where required (Action plans, inspections). • Some programmes provide assistance to improve HSE levels (workplace specific health safety and environment information). • Achieving the required levels of performance, standard met.		
Effectiveness of health safety and environment management and level of achievements in company is approved.	Yes	No
	√	

Comments / observations: Because all aspects graded 2 and better, effectiveness of health safety and environment management and level of achievements.
Reviewer signature:

Table 6.3: Case Study No.1: Review Findings and Judgments in Respect of the Six HSE Aspects

6.6.3 Discussions of case study No.1

The effectiveness of health safety and environment management performance and level of achievements in the International Oil and Gas Exploration and Production Company is approved in respect of all aspects as an acceptable contribution to the attainment of the stated HSE standard. The reviewers came to an overall conclusion on effectiveness of health safety and environment management performance and level of achievements, based on the review visit and an analysis of the self-assessment, together with additional data provided.

There are some elements of best practice in the exploration and production division in the case study company that the reviewers found encouraging. The major strengths identified during the visit include the fact that the company has done the following:

- Identified the existing or potential hazards through hazards assessment.
- Implemented hazards prevention and control measures.
- Implemented HSE surveillance procedures in consultation with a variety of stakeholders.
- Communicated well all aspects of HSE to all employees at all levels.
- Evaluated Exploration and Production (E and P) activities on the basis of accurate description.
- Maintained an effective routine and periodic check list record of activities to continuously enhance HSE in respect of Exploration and Production plans (Questionnaire).

On the other hand, the company needs to carry out the following:

- Minimize disturbance to wildlife, environmental damage and risk of marine accidents, when conducting seismic surveys.
- Improve its HSE-preparedness and environmental and cultural sensitivity by working closely with local authorities and communities. This is essential for reducing the impact on the environment and local subsistence lifestyles.
- Follow a strict “no spills” policy; no garbage or contaminants of any kind may remain on site after the crews leave, so that there is zero impact on the environment.
- Adopt higher standards for specialised equipment, crew training, and zero impact methods in order to preserve the environment.
- Articulate in a clearer manner the HSE policy.
- Ensure that a personnel employed possesses requisite experience, knowledge, skills, and abilities that are necessary to discharge their responsibilities in respect of HSE.
- Improve in capacity building programs of the company by evolving an appropriate system to assess and identify skill building and competence needs.
- Monitor more closely HSE procedures used and more particularly the potential levels of exposure to VOC, Naturally Occurring Radio Active Materials (NORM) and noise, which must cover the following compounds: Benzene, Gas, Xylenes, Hydrogen sulphide and Vapour.
- Find an appropriate methodology to provide all stakeholders including employees with HSE information and resources especially by non-Arabic speaking employees.

6.7 Case study No.2: A petrochemical company in Libya

This second company is a petrochemical company in the second industrial city in Libya near the Tunisian border. The factory currently has 515 employees, and the main activity is to produce a variety of petrochemicals and polymers products.

6.7.1 Company HSE standards

Key data derived from the documentation received from the company in respect of HSE standards is summarised below:

- Creates and sustains a work environment that is healthy and safe for employees, visitors and community.
- Considers and communicates potential risks to HSE when performing daily work duties.
- Carries out orientation and capacity building education and training needs analysis.
- Identifies and deals with the risks to health safety and environment at the earliest opportunity, and has a positive impact on HSE protection of the workforce.
- Tailors specific programmes to all categories of workforce employees, visitors and community by making the learning and control measures relevant to people.
- Tailors health surveillance and other controls to fit all gas product risks.
- Establishes robust emergency and crisis management plans using UNEP awareness and preparedness for emergencies at local level (APELL) and implements rehearsals and drills to simulate major events.
- Participates in sharing information with similar industries through trade associations and good practices from United Nations International Emergency Network.

6.7.2 Overview of findings

Key findings of the specialist reviewers based on the six HSE aspects are given in Table 6.4.

Record keeping and findings.
A Petrochemical Company.
Reviewer:
Date:

HSE aspect: Prevention.	Grade points: 2
Evidence: • Employees have acceptable understanding of HSE hazards that the workforce visitors and community is exposed to. • No written health safety and environment policy. • Plant management is aware of risk assessment requirements and programme is in place. • No system in place to identify professional development education and training needs (Risk assessment records). • Risk assessments reviewed from time to time (Review records). • Aspect makes acceptable contribution to the attainment of stated policy and strategy, but significant improvement could be made. • No major deficiencies and required levels of performance appear achievable without extensive extra activity, Standard almost met.	
HSE aspect: Surveillance.	Grade points: 3
Evidence: • Relevant hazardous substances regulations, codes and guidelines consulted and followed (Monitoring records) • Communication between employer and employees concerning health safety and environment surveillance seems fair. • Overall review of processes is planned. • Early Hazards detection procedure implemented. • Achieving the required levels of performance, standard met.	
HSE aspect: Response.	Grade points: 3
Evidence: • Company has allocated HSE representative responsible for health safety and environment matters (Company chart). • No booklet for employees to fill in if they spot any hazards (Hazard booklet). • Investigation drawn up for each operation. • HSE strategy articulates clearly the requirements of everybody from top to down in the organisation. • Supervisor consults and involves workers and shop floor employees and representatives effectively. • Achieving the required levels of performance, standard met.	
HSE aspect: Achievement.	Grade points: 2
Evidence: • No analysis of all workplace conditions to identify and eliminate existing or potential hazards from oil used and raw material. • Factory needs mechanism to ensure correct use, storage, and replacement of (PPE). • Team investigates each accident/near miss (Action plans). • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.	
HSE aspect: Resources.	Grade points: 2

<table>
<tr><td colspan="3">Evidence: • Some signage in place in the appropriate areas. • Employees given information relevant to them. • Recently purchased video to enhance health safety and environment induction. • Employee HSE manual. • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.</td></tr>
<tr><td>HSE aspect: HSE management and enhancement.</td><td colspan="2">Grade points: 3</td></tr>
<tr><td colspan="3">Evidence: • Both employees and employers have good understanding of HSE duties and responsibilities. • Good system in place to ensure action/control measures identified and taken where required (Action plans, inspections). • Company is keen on workforce and shop floor employee participation. • Safe and secure systems of work drawn up for majority of higher risk activities. Provided for all levels of workforce employees, who read and sign them. • Achieving the required levels of performance, standard met.</td></tr>
<tr><td rowspan="2">The effectiveness of HSE management and level of achievements in the company is approved.</td><td>Yes</td><td>No</td></tr>
<tr><td>√</td><td></td></tr>
<tr><td colspan="3">Comments / observations: Because three aspects from six graded 2, effectiveness of health safety and environment management and level of achievements in company approved but company needs to include improvement plan.</td></tr>
<tr><td colspan="3">Reviewer signature:</td></tr>
</table>

Table 6.4: Case Study No.2: Review Findings and Judgments in Respect of the Six HSE Aspects

6.7.3 Discussions of case study No 2

The effectiveness of health safety and environment management performance and level of achievements in this petrochemical company are approved. All aspects make at least an acceptable contribution to the attainment of the stated HSE Standards. The reviewers came to on overall conclusion, based on the review visit and an analysis of the self-assessment, together with additional data provided.

There are some elements of best practice based on lessons learned in the production process of the petrochemical company that the reviewers found encouraging. The major strengths and success story identified during the visit include:

- Acceptable level of understanding from the workforce and management after personal visit and detailed discussions on questionnaire regarding the HSE hazards in the workplace.
- Effective schemes for measuring and monitoring HSE as evidenced from the responses on questionnaire in the petrochemical production area.
- Good inspection and audit system in place as evident from responses to ensure action measures are identified and taken in to account for implementation where required.

On the other hand, the company needs to consider the following recommendations:

- Prepare and issue a written statement of a clearer HSE policy.
- Implement a range of blended learning methods which address the vocational nature of the capacity development programmes and support the development of employees as autonomous learners.
- Launch professional development and continuous education programmes tailor-made to teach the workforce and shop floor employees including the managers on how to obtain the HSE resources and information.
- Review and update risk registers regularly.

6.8 Case study No.3: An oil services company

This case study is about an oil services company situated in Tripoli, the capital city of Libya. The company currently has 95 employees, and the main activity is oil and gas industry related services such as drilling, mud logging, drilling fluid, coring, cementing, and well testing, as well as an environmental solution provider in respect of procurement, training, consultancy, and support activities related to all aspects of 2D and 3D Seismic surveys for Exploration and Production and HSE.

The mud logging production unit was the basis of the review. The data in this introduction is confidential and given on the condition that it will be used for academic purposes only by the company.

6.8.1 Company HSE standards

Key data derived from the documentation received from the company in respect of HSE standards is summarised below:

- Provide a written statement on mission, values and policy for HSE.
- Establish emergency plans and implements drills to simulate major events.
- Provide a good understanding of the potential health safety and environment risks within the business.
- Have a provision for development of training needs analysis based on business risk profile and risk registers.
- Communicate potential risks to health safety and environment when performing daily work duties by all employees at various levels.
- Provide written statement for HSE protection.
- Standards do help establish emergency plans including fire protection and provide clear guideline to implement drills that simulate major events.
- Establish a good understanding of the potential HSE protection risks within the company specific business.
- Communicate potential risks to HSE when performing daily work duties.
- Understand how risks are best managed using Awareness and Preparedness for Emergencies at Local Level (APELL) model that enhances raised awareness and getting prepared to control the quality of information, instruction and training that needs to be given to relevant managers, middle staff and shop floor employees.
- Provide a mechanism that promotes a participation process to share information with similar business through workshops, seminars, and conferences.
- Ensures that nothing supersedes safe working practices, even in a crisis situation.
- Provide a way forward in organising tailor made programmes to all categories of employees, making the learning and control measures relevant to people.
- Design tailors made company specific HSE surveillance and other controls to fit business risk profile.

6.8.2 Overview of findings

Key findings of the specialist reviewers based on the six HSE aspects are given in Table 6.5.

Record keeping and findings	
Company: An oil Services Company	
Reviewer:	
Date:	
HSE aspect: Prevention	Grade points: 3
Evidence: • Employees are not fully aware of their tasks, roles, functions, duties and responsibilities under the HSE regulations. • Management had some awareness of hazards employees are exposed to, but gaps in their knowledge. • Written statement of HSE policy. • System in place for control measures and emergency plans (Job safety analysis descriptions) • Risk assessments not reviewed (Review records). • Achieving the required levels of performance, standard met.	
HSE aspect: Surveillance	Grade points: 2
Evidence: • Health safety and environment (HSE) surveillance procedures are not fully developed in consultation with employer and employees. • Communication between employer and employees concerning HSE surveillance needs improvement. • Relevant hazardous substances regulations, codes and guidelines like Material Safety data Sheet (MSDS) are consulted and followed. • Workforce does make complaints to line manager, in hazards booklet. • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.	
HSE aspect: Response	Grade points: 2
Evidence: • The HSE strategy in the company is not clear and well defined. • Company has matrix of skills, abilities and competence needed for each job and who possesses them. • Lessons learned are not frequently reviewed. • Employees' work shadow more experienced operator to learn process and shown HSE procedures. • Company needs specialist consultant advice from outside and is trying to obtain it. • No major drawback and deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.	
HSE aspect: Achievement	Grade points: 3

Evidence: • Company has mechanism and measures in place to ensure correct use, storage and replacement of (PPE). • Analysis for all workplace conditions is carried out to identify and eliminate existing or potential hazards.		
• Work is evaluated on basis of accurate description (Job description). • Team investigates each accident/near miss (Action plans). • Achieving the required levels of performance, standard met.		
HSE aspect: Resources	Grade points: 1	
Evidence: • Company does not assign special resources to HSE activities on annual basis. • Information on PPE not passed on. • Employees given information only on general HSE rules. • Inherent difficulties are found in providing information for employees. • Significant action is needed to achieve the required levels of performance, Standard not met.		
HSE aspect: HSE management and enhancement	Grade points: 2	
Evidence: • Health safety and environmental protection manager set up a HSE management system. However, since his departure, health safety and environment management appears to be passive and not ongoing activity, with reliance placed on systems already in place. • No mechanism to test enhancement of advanced evaluation of conclusion plans. • Acceptable system in place to ensure action/control measures identified and taken where required (action plans, inspections) • Some programmes which provide assistance to improve HSE levels (workplace specific health safety and environment information). • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.		
Effectiveness of health safety and environment management and level of achievements in firm approved.	Yes	No
	√	
Comments / observations: Because one aspect graded 1, and two aspects graded 2, three aspects graded 3 effectiveness of health safety and environment management performance needs further review within a period of time.		
Reviewer signature:		

Table 6.5: Case Study No 3: Review Findings and Judgments in Respect of the Six HSE Aspects

6.8.3 Discussions of case study No 3

Effectiveness of health, safety and environment management performance and level of achievements in the oil services company is examined before approval. Further periodic review is planned within a defined period of time. All the analysis on six aspects stated earlier does help make an acceptable contribution to the attainment of the stated HSE standards. The reviewer's observations and findings in terms of their concluding report are based on the review visits and an analysis of the company self-assessment together with additional data if any.

The elements of best practice identified during the visit include:

- Clear strategies for timely interventions as support and guidance, in the form of comprehensive written statement of HSE policy.
- Good effort to apply modern system of capacity building including training system.
- Effective schemes and alternatives for analysing all workplace conditions to identify and eliminate existing or potential hazards.
- Good evaluation of the work in progress on the basis of accurate description.
- Availability of programs that provides assistance to improve HSE levels.

However, the company needs to consider the following recommendations:

- Improve employees' awareness and preparedness to respond to their duties and responsibilities under the HSE regulations.
- Improve better communication channels between the employer and employees concerning HSE surveillance.
- Seek specialist advice from outside regarding health safety and environment resources and information.
- Seek and use health safety and environment resources.

6.9 Case study No.4: Refinery company

This case study is about a Libyan refinery company located in the west near Tripoli. The refinery started production in 1974 and it currently produces an estimated 120,000 barrels (19,000 m3) of oil per day. It is a topping and reforming refinery having a distillation capacity of 6,000 tons per annum. The refinery is operated by the Zawia oil refining company, a subsidiary of the National Oil Corporation (NOC).

In 2006, the refinery started a project to increase its capacity of 120,000 bbl/d (19,000 m3/d) by 24 percent. This involved the installation of a new continuous catalytic reformer (CCR) unit, naphtha and gas-oil hydro theatres and an isomerisation unit, as well as the installation of pneumatic control units and a supervisory control and data acquisition (SCADA) system. The company currently employs over 950 employees, and the main business activity is to refine crude oil. The processing unit was the basis of the review.

6.9.1 Company HSE standards

Key data derived from the documentation received from the company in respect of HSE standards is summarised below:

- It carries out capacity development programmes to identify training needs using analysis based on business risk profile and risk registers.
- It tailors HSE surveillance and other required controls to fit the business risk profile.
- It participates in sharing information with other refining industries through meetings, conferences and trade associations.
- It runs wellness programmes and promotes good personal health to encourage employees to be proactive about their personal health and safe environment.
- It helps establish occupational health risk profiles and registers to record and prioritise hazards and document preventative measures.
- It consults all stakeholders including employees and involves them in the decision making process.

6.9.2 Overview of findings

Key findings of the specialist reviewers based on the six HSE aspects are given in Table 6.6.

Record keeping and findings	
Company: Refining Company	
Reviewer:	
Date:	
HSE aspect: Prevention	Grade points: 1
Evidence: • Awareness of hazards not acceptable. • Structural safety not adequate across the company. Moreover, there was no written manual or system for HSE. • No system in place to identify training needs. • Significant action is needed to achieve the required levels of performance, Standard not met.	
HSE aspect: Surveillance	Grade points: 1
Evidence: • No evidence of any systemic effort to ensure examination and testing procedures for HSE surveillance appropriate and adequate. • No communication between employer and employees concerning HSE surveillance. • No thinking about formal monitoring of housekeeping. • Workforce cannot make complaints to line manager. • Significant action is needed to achieve the required levels of performance, Standard not met.	
HSE aspect: Response	Grade points: 1
Evidence: • Company has not allocated safety representatives responsible for HSE matters. • Lack of HSE strategy. • Employees not trained at all for any emergency cases. • Company needs specialist advice from outside and there is no trying to obtain it. • Significant action is needed to achieve the required levels of performance, Standard not met.	
HSE aspect: Achievements	Grade points: 1
Evidence: • Work not evaluated on basis of accurate description. • No regular purchases list of safety tools and (PPE). • No analysis of all workplace conditions to identify and eliminate existing or potential hazards. • No accident reporting and investigation. • Significant action is needed to achieve the required levels of	

performance, Standard not met.		
HSE aspect: Resources		Grade points: 2
Evidence: • Company does not assign special resources to health and safety activities on annual basis. • Some notice boards and warning signs fixed in production area. • Employees given information relevant to them about potential hazards.		
• Difficulties in providing information to employees because many do not speak/read Arabic or English, and unawareness of what language they do speak. • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.		
HSE aspect: HSE management and enhancement		Grade points: 1
Evidence: • Company still far away from implementing complete set or requirements of any national or international standard. • No mechanism to test enhancement of advance evaluation of conclusion plans. • No system in place to ensure action/control measures identified and taken where required. • Absence of safety maintenance programme. • Management think company is small and has no need to complicate their life. No huge equipment sophisticated or dangerous to employees or environment. • Significant action is needed to achieve the required levels of performance, Standard not met.		
Effectiveness of HSE management and level of achievements in the company is approved.	Yes	No
		√
Comments / observations: Because most aspects graded 1, effectiveness of HSE management performance needs further review within period of time.		
Reviewer signature:		

Table 6.6: Case Study No 4: Review Findings and Judgments in Respect of the Six HSE Aspects

6.9.3 Discussions of case study No 4

The effectiveness of HSE management performance and level of achievements in this refinery company is clearly unsatisfactory, and needs further comprehensive review within a short period of time. All aspects except one do not make an acceptable contribution to the attainment of the stated HSE standards, because there are major shortcomings that must be rectified as soon as possible. The reviewers came to all overall conclusion based on the assessment visit and an analysis of the self-assessment, together with additional data provided.

The major strengths identified during the review visit include:

- Qualified staff employee relations, flexibility of the staff, and their responsive attitude towards the particular needs of the employees.
- Top management effort to provide the employees with information relevant to them about potential hazards.

The following areas of weakness were highlighted:

- Lack of HSE awareness.
- Lack of HSE education and training.
- Low level of HSE maintenance programme.
- No written procedure for HSE systems of work or HSE monitoring systems.
- Number of first aid boxes was very limited in the refinery.
- Lack of attached clinic with G.P.
- No reference to emergency phone fixed in a clear place.
- No regular purchases list of safety tools and PPE.
- Lack of accident reporting and investigation.
- Inappropriate health surveillance and other controls to fit business risk profile.
- No written statements for HSE.
- No system for ensuring that nothing supersedes safe working practices, even in a crisis situation.

6.10 Case study No.5: A drilling mud company

This case study is about a drilling mud company situated in the second largest city in Libya. The company currently employs 680 employees and the main activity is to produce all water based, oil based and synthetic mud. The mud production unit was the basis of the review.

6.10.1 Company HSE standards

Key data derived from the documentation received from the company in respect of HSE standards is summarised below:

- They encourage employees to give ideas, views and suggestions that will have a positive impact on health safety and environment.
- They consider and communicate potential risks to HSE.
- They reduce HSE risk to employees, customers, contractors, and the public.
- They carry out a training needs analysis based on business risk profile and risk registers.
- They participate in sharing information with similar industries through trade associations.
- They provide tailor-made programmes to all categories of employees, making the learning and control measures relevant to people.
- They establish robust emergency plans and implement drills to simulate major events.
- They implement return to work programmes to ensure that injured or ill employees re-join the workforce as quickly as possible.
- They include HSE as an important agenda items on all management meetings.

6.10.2 Overview of findings

Key findings of the specialist reviewers based on the six HSE aspects are given in Table 6.7.

Record keeping and findings	
Company: Drilling Mud Company	
Reviewer:	
Date:	
HSE aspect: Prevention	Grade points: 3

Evidence: • Aware of most of relevant hazards, including dust, fume, etc., and if action not already taken, then plans in place to carry out actions. • Formal mechanisms to ensure HSE systems and procedures reviewed regularly. • Workforce has acceptable understanding of hazards in production area. Wear PPE majority of time. • Risk assessments regularly undertaken and reviewed (Risk assessment records). • Manager told us that he sometimes has to take authoritarian approach with employees about HSE matters. • Achieving the required levels of performance, standard met.	
HSE aspect: Surveillance	Grade points: 3
Evidence: • The HSE surveillance procedures developed in consultation with employer and employees (Monitoring records). • Any particular pressing issues can be addressed in daily meeting between manager and supervisors. • Company constantly looking forward and planning future improvement. • Maintenance contracts in place to keep machines in good order. • The company has relevant hazardous substances regulations consulted and followed (Monitoring records).	
• Achieving the required levels of performance, standard met.	
HSE aspect: Response	Grade points: 2
Evidence: • The HSE strategy in the company is not clear. • Company needs specialist advice from outside and is trying to obtain it • Employees' work shadow more experienced operator to learn process, and shown safety procedures. • Company has matrix of skills needed for each job and who possesses them? • Lessons learned not reviewed. • No major deficiencies and required levels of performance seem achievable without extensive extra activity, Standard almost met.	
HSE aspect: Achievements	Grade points: 3
Evidence: • Employers and employees involved and communicate on workplace safety and health issues (Staff briefing). • Workplace evaluated on basis of accurate job descriptions (Job description record). • Staff and employee performance recognised and rewarded (Staff training records). • Achieving the required levels of performance, standard met.	
HSE aspect: Resources	Grade points: 4

<table>
<tr><td colspan="3">Evidence: • Company assigns special resources to HSE activities on annual basis (Workplace specific HSE information) • Safety chart and notice board with health and safety booklets on it (Health safety and environment booklets). • Manager informs employees on use of resources information management systems (Own health safety and environment information). • All staff adequately trained with regards to HSE. (trainings programme) • Necessary information disseminated to employers and others (Induction records). • Posters and information related to health and safety programmes positioned around workplace. • Aspect makes full contribution to attainment of stated policy and strategy.</td></tr>
<tr><td>HSE aspect: HSE management and enhancement</td><td colspan="2">Grade points: 2</td></tr>
<tr><td colspan="3">Evidence: • No clear mechanism to test enhancement of advance evaluation of conclusion plans. • Mechanism to update HSE management guidelines and issues needs improvement. • Limited cooperation with overseas countries in improving industrial health safety and environment • low required levels of performance, Standard downgraded.</td></tr>
<tr><td rowspan="2">Effectiveness of HSE management and level of achievements in the company is approved.</td><td>Yes</td><td>No</td></tr>
<tr><td>√</td><td></td></tr>
<tr><td colspan="3">Comments / observations: Because all aspects graded 2 and better, effectiveness of health safety and environment management and level of achievements in firm is approved.</td></tr>
<tr><td colspan="3">Reviewer signature:</td></tr>
</table>

Table 6.7: Case Study No 5: Review Findings and Judgments in Respect of the Six HSE Aspects

6.10.3 Discussions of case study No 5

The effectiveness of HSE management performance and level of achievements in the drilling mud company is approved. All aspects make at least an acceptable contribution to the attainment of the stated HSE standards. The reviewers came to an overall conclusion, based on the assessment visit and an analysis of the self-assessment, together with additional data provided.

The elements of best practice in the production provision in the company that the reviewers found encouraging include:

- They have a clear commitment to achieving aims lay down in the company mission.
- They have implemented hazards prevention and control measures.
- They have a very good information provision.
- They have evaluated work on the basis of accurate description.
- They have good care and support for employees.
- They have a good progression rate and employment record of employees.
- They have an excellent condition of company buildings.

The company can build on these strengths by considering the following recommendations:

- They need to improve procedures used for monitoring HSE in the workplace.
- They need to improve communication between the employer and employees concerning HSE surveillance.
- They need to increase cooperation with overseas countries in improving HSE in oil and gas sector.

6.11 Revision of the HSE performance review methodology

In the light of experience gained from the validation review visits, feedback received from the HSE experts involved in the validation, and the observations made by the researcher and review team, a number of minor modifications were identified to the first version of the review methodology. These are outlined in the sections below.

6.11.1 Rationale for the revised version of HSE review methodology

A structured method for revising the HSE performance review methodology was used to capture lessons learned from the direct application of the methodology – not only from the review team but also from the companies reviewed in the pilot. They are divided into four sections as below:

1) General information.
2) Self-assessment information.
3) Ordering importance of HSE aspects and ranking their indicators.
4) Review methodology development.

Discussions around the above questions have yielded the following minor modifications, which have been recommended by the review team and representatives of the companies reviewed:

- HSE standards were seen as a critical point for the majority of companies when they were asked to complete their self-assessment. It was suggested to give the companies more flexibility to express their policy and strategy in the way they saw fit.
- A minor change to three of the six HSE aspect titles was suggested, as described in the next section.
- The grading profile was suggested to be expanded to include a further grade (new grade ‘3’), making 5 grades in total. This grade was suggested in order to address the common situation of companies having a partial implementation approach to HSE aspects, in that they have a systematic approach in some areas.

6.11.2 Revised review aspects

The minor changes recommended in respect of the HSE aspects are outlined below and shown in Table 6.8 below.

- It was recommended to change ‘Prevention’ aspect to ‘Hazard Prevention and Control’ aspect, which is considered to be more meaningful, as a number of reviewers found difficulties in interpreting the previous one.
- It was recommended to add ‘information’ to the ‘Response’ aspect, to become ‘HSE Response Information’ to show how HSE information is regularly discussed with employees.
- It was recommended to add ‘control’ to ‘Achievements’ to become ‘Achievements and control’ to clarify how far performance in HSE and controls are working.

No	HSE aspect
1	Hazard Prevention and Control
2	Surveillance
3	HSE Response Information
4	Achievements and Control
5	Resources
6	HSE Management and Enhancement

Table 6.8: Revised HSE Aspects

Accordingly, the revised review methodology is nearly the same as its first version. The proposed validation plan was recommended to stand in order to test, more practically, the merits of review methodology.

Chapter 7: A PROPOSED IMPLEMENTATION PLAN FOR THE HSE PERFORMANCE REVIEW METHODOLOGY IN LIBYA

7.1 Suggested framework for the proposed review methodology

The suggested HSE performance review methodology included here provides the general requirements for its successful implementation. It is based on the following components:

- A comprehensive review of entire oil sector related upstream downstream and midstream industries in Libya.
- The review visit takes varying amount of time ranging from 3 to 5 days depending upon the size of the company.
- Peer reviewers as given in paragraph 6.2 earlier states that four are drawn from public sector i.e. NOC, UNCSD, LNCSM and remaining two from private enterprises with health safety and environmental and EGA Authorities protection background experiences.
- A draft audit report is completed on the last day of the audit by the reviewers after incorporating corrective actions based on factual inaccuracies and deficiencies.
- The final audit report is prepared within a month from the last day of review.

Since the HSE Review Methodology is used periodically, it is necessary to train a group of individuals in each of the upstream, downstream and midstream segment of oil and gas industry.

The review assessment gives a ‘snapshot’ of the HSE management performance at that time, and may not include plans made by the concerned case study companies.

The review needs to be carried out at two levels as shown below:

- Randomly selected upstream, midstream and downstream segments (approximately 50) are compared on a yearly basis as a reflection of the total oil sector in Libya.
- A case study of 10-12 companies, which go back to each year as a mini parallel research.

The Review Methodology is used to measure performance before one off initiative, e.g. a sector specific initiative to establish baseline, and then repeated following, or during, the initiatives to measure changes. This could be done as part of the yearly assessment, with the inclusion of additional, specific questions in relation to one or two HSE aspects, e.g. HSE surveillance.

7.2 Review methodology using grades and rankings

Numerous ways as stated earlier in chapter 4 and chapter 6 are used for which the ranking and grades is obtained for the Review Methodology to present an overview of performance within the oil sector in Libya. For example, the mean grades for the HSE aspects is treated as an indicator to identify periodic trends, and the companies receiving each of the grades use it to plot such trends. The total sample is divided to assess topics of interest, depending upon size of company. This pertains to case study companies which are part of larger organisations (compared with those which are entirely 'standalone'), or by process (e.g. compression versus injection moulding in the other sector).

The grading system was refined in consultation with oil sector companies to reflect industry standards, e.g. the upstream, mid-stream and downstream industries in oil sector. It helped to rightly define what an acceptable system is compared to a good system.

Feedback of the review findings was presented and discussed with the HSE managers and inspectors of oil and gas case study companies. The HSE team, who had their own summary of each HSE aspect, was also considered in respect of relevant HSE sections and clauses for the case study company. A mutual agreement was reached on criteria only for grading HSE aspects with commitment of no interference by company what so ever.

7.3 Proposed implementation plan

This section presents a summary of process plan for implementing the proposed HSE performance review methodology for oil and gas sectors in Libya. The plan is based on ideas generated from the various lessons learned from the implementation of similar systems such as the Quality Assurance Agency's Subject Review (Brown, 2004) and (Al-Qahtani, 2007). The implementation plan for the HSE performance review methodology need to include the following categories:

1. Planning.
2. Development.
3. Training.
4. Implementation.

Each of the above is discussed in the sections below.

7.3.1 Planning

Keeping in mind of the fact that culture, customs, traditions and value system are crucial elements of the plan before implementing any new system in any company. All oil sectors related company levels need to be made aware and get prepared prior to introducing the HSE Performance Review Methodology. This starts with the commitment at the top and down to the last employee in the company. All employees need to be made aware of the significance of the HSE Performance Review Methodology and its future benefits. Companies need, therefore, to create a culture where all employees do understand and fully participate by getting involved in the HSE Performance Review programmes relevant to their workplace.

The first step is to identify major gaps and shortfalls between the oil sector related industry and the Authorities by promoting a supporting trust making, trust building and trust keeping environment on both sides. This is achieved by arranging a number of workshops and awareness-raising seminars about the role and responsibilities of both parties. This will enhance the industry's stakeholders' perception towards the Authorities.

The steps to be undertaken in setting up a comprehensive plan are:

- Identifying external and internal opportunities, threats, strengths, and weaknesses of the oil and gas company.
- Identifying processes to be focused on, and the likely hazards and related control measures (self -assessment).
- Identifying long term ambitions plans of the Industry business collectively.
- Identifying a good number of specialist reviewers capable of carrying out their duties effectively.
- Analysing, evaluating the findings and taking appropriate actions.
- Setting targets of achievement for the oil and gas companies and the NOC collectively to attain higher HSE management performance.

The oil and gas companies HSE Performance Review Methodology to its employees. The communication plan needs to be both comprehensive and periodic. This requires use of various communication devices to introduce the Review Methodology such as executive announcements, stakeholders meetings, videos, town meetings, brochures and newsletters. The purpose of the communication strategy includes the following:

- Convincing NOC Authorities in Libya and seeking consent for use of the proposed HSE management performance review methodology is critical in its successful introduction and implementation. This process is aimed at convincing and seeking support of all responsible persons in the NOC so that they understand the strategies required as guidelines with the ultimate goal to evaluate the effectiveness of health safety and environment management performance in the entire oil and gas industry, and provide some form HSE achievements. It is therefore required to help in identifying whether there is a systematic approach to managing HSE concerns rather than merely carrying out a formal conventional audit of a paper based system (or equivalent).

- Presently, over 70% of Libyan companies do have or are working with at least one HSE management system. The other 30% are planning to establish a new management system within the next eighteen months from this year 2013.

7.3.2 Development

All oil sector companies that are required to implement the Review Methodology need to have clear mission, values, vision, and strategy in place. Since the HSE Performance Review Methodology is mainly concerned with the implementation of already planned strategies, it must help to translate the company mission, values, vision, and strategy into HSE standards and rules. It is required as a part and parcel of the review needed in respect of each aspect of the HSE Performance Review Methodology.

The critical factors of performance for both the oil and gas sectors and the NOC Authorities in Libya are its regular day-to-day routine and periodic monitoring. The most important factors, which need to be monitored include:

- Social and financial performance of the oil sector related companies and related industry business.
- Oil sector business unity, cohesion and dynamics based on the industry constitution designed collectively by the stakeholders.
- Direction of communication in the oil and gas companies and the oil sector in Libya.
- Oil and gas company culture, attitudes, values, and beliefs of its employees as partners of Libya and employers participating in the NOC.

7.3.3 Training

The HSE Performance Review Methodology is essentially a new approach for the oil and gas sectors in Libya. It is designed to adapt and adopt new perspectives and processes to introduce innovation and change in Libya. This requires capacity development through employers' training and education initiatives that help facilitate this change by providing employees with the knowledge and skills required to adapt and lead this change process. The target of training is supported by the review team, where in the role employee’s play in exercising sound business judgment, and the specific techniques for implementing HSE Performance Review Methodology.

Each oil sector related company sets its self-assessment procedures using the six derived aspects. These are included in the National Capacity Self-Assessment (NCSA) guidelines developed by GEF-UNDP project of Environmental General Authority (EGA). These are reviewed and finally agreed by the review chair and the review team.

HSE aspects measure performance-linked corporate goals by tracking performance across the Review Methodology aspects. By demonstrating the cause and effect relationships between HSE aspects, and the Review Methodology provides managers with an obvious understanding of how their decisions impact not only on their direct area of responsibility, but also on other departments and the overall company strategy.

The Review Methodology measures need to be determined according to cause and effect linkage in the Libyan context. The designed HSE Performance Review Methodology relevant to Libyan situation illustrates the companies’ strategy through the HSE aspects chosen. These aspects are linked together in a chain of cause and effect relationships.

7.3.4 Implementation

The Review methodology is designed so that it gets cascaded from top to bottom within the company. The oil sector related Libyan company starts its HSE Performance Review Methodology by writing the self-assessment in the upper level of the company, and then cascading to the lower level departments to determine their achievements and contribution to overall goals.

The rolling out of the implementation plan involves establishing relationships between HSE aspects so that the Review Methodology provides managers with an obvious understanding of how their decisions impact not only on their direct area of responsibility, but also on other departments and the overall company strategy.

Appropriate information systems should be used so as to help the HSE manager know and manage any unexpected problems when using HSE Management Performance Review Methodology. This is achieved, by gaining access to underlying data to explore the cause of any problem or analyse trend and correlations. The information system needs to be adequate to achieve the effectiveness of the Review Methodology.

The implementation of the Review Methodology is a key to HSE performance improvement. It will enable a quicker culture change, and it will provide more visibility in respect of HSE performance measurement.

It is vitally important to update and promoting the HSE Performance Review Methodology by linking it with incentives and rewards.

The review team needs to incorporate a number of changes in the reviews of each aspect. This requires changes in the company strategy due to sudden changes in internal or external circumstances. Therefore the performance measures need to be revised, updated and upgraded according to new circumstances. Despite changes of circumstances, the measures are evaluated and reviewed at least twice a year in conjunction with the company planning. In order to strengthen the HSE Performance Review Methodology implementation, the reward of executives and managers is tied with the results of the review measures.

Corporate alignment is a key for the HSE Performance Review Methodology implementation success. This requires considering both intangible and tangibles alignment with strategy in order to create value.

The HSE Performance Review Methodology needs to use benchmarking information to set targets. Benchmarking is used to incorporate existing best practice and to confirm that internally proposed targets will not keep the business unit trailing in review methodology. Consequently, the company needs to stretch its targets and performance indicators according to those targets of best in class.

The factors that need to be understood and rigorously monitored in respect of feedback and control are:

- Feedback of the oil and gas industry business performance on the benchmark of performance standards is monitored to constantly identify its direction of movement and forward thinking towards the set goals and objectives.

- Feedback from the oil and gas industry business about its satisfaction with the return of Authorities.

- Feedback from the oil and gas industry business about the brand image the Authorities that are responsible for having created the business.

- Satisfaction of concerned individual members of the industry business with the Authorities.

- Feedback about the oil and gas industry business interest in continuity in the Authorities.

7.4 Realising the HSE performance review methodology

The realisation of the HSE Performance Review methodology can be achieved through a thorough programme including:

- Change management.
- Promotion of benefits.
- Provision of ICT tools for capturing and reporting HSE data.

7.4.1 Change management

The HSE Performance Review methodology could readily be used to achieve the following:

1) Motivate change by:

   - Promoting the oil business case.
   - Launching common Standards.
   - Involving Insurers.

- Using the "Name and Shame" approach to motivate companies.

2) Enforce change by:
   - Enforcing compulsory Insurance.
   - Introducing penalties for non-compliances.
   - Start private prosecutions where appropriate.
   - Introducing the Directors' responsibilities.

3) Lead by example by:
   - Enforcing a comprehensive HSE checklist commensurate with the six aspects.
   - Requesting formal annual HSE reports.

4) Change the World of Work by:
   - Providing effective guidance.
   - Reviewing incident reporting regulations.
   - Amending existing HSE rules and regulations, where appropriate.
   - Reviewing HSE company structures.

5) Improve occupational health and safety by:
   - Providing better access to relevant data.
   - Reviewing the occupational health and safety strategy.
   - Providing guidance of rehabilitation.
   - Enforcing right to work as partners.

6) Promoting education by:
   - Improving the protection for all workers.
   - Including HSE in the Curriculum at technical study, secondary and higher education.

7) Involve employees by:
   - Providing training for HSE Representatives.

- Ensuring worker representation.

8) Engaging SMEs in HSE by:

   - Forging links with large companies.
   - Improving HSE representation through effective guidance and associated funding.

9) Involve the regions by:

   - Working with Local Authorities.
   - Working with the NOC.
   - Reviewing regional structures.

10) Modernising NOC by:

   - Promoting equality.
   - Enforcing openness.
   - Enforcing accountability.
   - Sharing information.

7.4.2 Promotion of HSE performance review benefits

These include:

- Enhanced availability of performance indicators.
- Improved data availability.
- Better prioritisation.
- Introduction of a single uniform system.
- Reduced paper work.
- Benchmarking and learning.

7.4.3 Provision of ICT tools for capturing and reporting HSE data

The proposal here is to develop a bespoke decision support system for managing all aspects of HSE in a structured, organised and real-time manner. The system would not only allow the capture of key data internally but it would also allow the reporting of such data in real-time. The decision support tool would be a secure web-browser based solution which companies could use for their own management of HSE as well as a mechanism for directly reporting issues as and when they occur.

The software would automatically provide NOC with a real-time Dashboard of all events and activities in so far as HSE is concerned locally, regionally and nationally. The software can be used to remotely audit companies and only carry out review visits when necessary.

7.4.4 Tangible outcomes for HSE performance review methodology in Libyan oil and gas companies

- An efficient alerting mechanism to automatically warn companies of hazardous situation in an accurate and timely manner.
- Economic gains in terms of efficiency, effectiveness and improved compliance with many standards.
- A simplified approach with consistency and holistic manner to drive and achieve strategic planning with reduced administrative cost.
- Improved visibility of key performance indicators with improved transparency and consistency of management system.
- Consistent risk management methods and improved opportunities to prioritize key issues.
- A single system with standardised and integrated HSE methods and evidence based documentation.
- Enhanced corporate governance and more opportunities for benchmarking.
- Visibility of good practices in integrated HSE.
- Handling of audits with reduced workload required before, during and after review visits.
- More efficient ways for inter and intra companies data sharing on performance indicators.

Chapter 8: CONCLUSIONS AND RECOMMENDATIONS

8.1 Research overview

This research has presented a comprehensive study of HSE management framework and performance review applied to the oil and gas industry in Libya. It included all aspects of HSE. It treated HSE as an integrated way including:

- Advising on safety and industrial hygiene regulatory requirements and best practices.
- Developing safety procedures and guidelines.
- Conducting safety and environment inspections and audits.
- Conducting exposure assessments and monitoring.
- Evaluating and addressing economic risks.
- Advising on strategies to improve health, safety and environment performance review.
- Promoting compliance.
- The related environmental protection issues include aspects on how to:
- Advise on international Libyan environmental regulatory requirements and best practices.
- Work with regulatory agencies like LNCSM, NOC and EGA to obtain permits.
- Develop environmental procedures and guidelines.
- Perform studies to estimate and reduce emissions.
- Implement waste management programs.
- Access and manage environmental, social and health impacts.
- Assess control technology.
- Work to ensure compliance.

The key aim of the research is to outline strategies which may guide Libyan oil and gas industry controlling authorities, as well as others, in their ultimate role to evaluate the effectiveness of health safety and environment management system performance. This is vital for sound management of production and efficiency of oil and gas and its processing if Libya is to achieve sustainable development, including the imminent threat to combat climate change, eradication of disease, the improvement of human health and environment also elevation and maintenance of the standard of living in the country at all levels. The oil and gas sector includes upstream, midstream and downstream petroleum industry; i.e. exploration and production of crude oil, refined products from refinery, and petrochemical industrial branches. These have been selected in this research because of their characteristics as high-risk industry with significant economic importance as a major Libyan income provider, but also because of the researcher's long experience in the same industry.

The research outcomes are heavily based on an extensive literature review as well as empirical studies including a pilot study, interviews, structured questionnaire, and case studies. The literature search helped to review the state-of-the-art in respect of HSE. Good progress has already been made in international oil and gas production and improved management. Progress has also been made in addressing particularly hazardous petrochemicals through the recent entry into force of the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Petrochemicals in International Trade, and the Stockholm Convention on Persistent Organic Pollutants (POP) (Stockolm, 2004) and the adoption of the Globally Harmonised System for the Classification and Labelling of Chemicals including petrochemicals. The current research is in response to the wakeup call for the use and further development of the Global Plan of Action, to address current and ever-changing societal needs, as a working tool and guidance document and creation of oil and gas sector related HSE capacity development for meeting, the commitments to maximisation, efficiency improvement and waste management expressed.

The, structured interview questions have been designed and developed to collect data from a large sample of both domestic and international oil companies, in order to identify the applicability to the Libyan oil and gas industry of the HSE aspects obtained from previous similar studies. Based on the comprehensive discussion and interpretation of the results, a generic structured HSE management performance review methodology for the oil sector related companies in Libya has been proposed.

8.1.1 Research contributions

It is contended that theoretical, methodological, and practical findings from the present research have been achieved as discussed in the sections below.

8.1.1.1 Theoretical contributions

This pertains to a theoretical body of knowledge, as far as HSE management performance is concerned. Even though many Libyan domestic and international oil companies of different sizes and types have contributed and endeavoured in multifarious ways to review and measure HSE management performance, most of them are not truly based on a specific theoretical foundation. This research can be rightly and truly considered as a step or way forward towards theory building. The methodology developed has focused on a large body of literature relevant to HSE management performance. In particular, the research has been meaningful and effective in identifying, defining and describing HSE aspects that lead to a holistic and integrated approach to HSE management performance especially related to Libya based both domestic and international oil companies of different sizes and types. Not only has the research helped in providing an empirical review of the essential elements in HSE management performance, but it has also helped establish the much needed change from reviewing loss type accidents to reviewing the prevention aspects of potential occurrence of accidents before they occur, i.e. to embrace a proactive approach rather than a reactive one. The research has also helped in developing a successful HSE management performance framework based on review of activities that is crucial in organisational of much needed sustainable competitive advantage across all the upstream, midstream and downstream areas using RS and GIS technologies that are capable of introducing measurements to forecast potential incidents, accidents or activities before they occur. This requires nationalisation of these technologies through building a team of qualified nationals, capable of carrying out RS and GIS tasks, supporting decision in all aspects of upstream, midstream and downstream oil and gas industry. There is an urgent need for building a platform for spatial data management to facilitate information retrieval, data organisation and preservation, data sharing and communication. It would also require Decision Support for HSE and waste management planning through simulating and analysing different scenarios and plans.

8.1.1.2 Methodological contributions

The triangulation plan of combining quantitative and qualitative approaches as outlined in this research enhances and enriches the understanding of the subject by allowing an insight into the emerging dimensions, trends, techniques and technologies. It is found that any study merely based on either quantitative or qualitative strategy alone is insufficient to obtain key aspects of HSE and this deeper understanding, though a single method (quantitative or qualitative) that has been mainly applied in most of the earlier empirical studies. Therefore, the present research is a contribution to the methodology of research on HSE management performance by demonstrating triangulation in qualitative and quantitative methods. While the quantitative study has amply served as a complementary study to further assess and test the applicability of critical aspects of HSE and to investigate any potential benefits or obstacles associated with it, the qualitative study too has provided useful information in the formulation of the six aspects.

8.1.1.3 Practical contributions

The highlights and findings of this important research are relevant to all the different Libyan domestic and international oil companies of different sizes and types. These study findings are equally applicable and provide an insight as a contribution to industry sectors in general.

Perhaps the single most important contribution of the research of HSE issues in Libyan domestic and international oil companies of different sizes and types is a first attempt to review HSE management performance in a cooperative, comprehensive and continuous manner. This research took a snapshot of the state of HSE to prescribe some relevant strategies to direct the Libya Authorities in their effort to enhance the reviewing of HSE management performance.

This research has contributed to help recognize a series of critical issues that need to be addressed and must be carefully considered to ensure the successful reviewing of HSE management performance. These factors have thus provided a way forward to resolve HSE issues in the proposed review methodology.

It is hoped that the review methodology as proposed in this present research would help enhance the current practices of HSE management performance, and move away from narrowly focused, ad-hoc, and piecemeal approach.

8.1.2 Research aim and objectives revisited

The motivation for this important research was triggered by the following two oil and gas industry major concerns:

1. How meaningfully and effectively can Libya handle domestic and international oil companies' HSE management performance review?
2. How can Libya enhance HSE, security and environmental management in domestic and international oil companies, and manage major incidents successfully?

The comprehensive research described in this thesis offers the following responses to the above two major concerns.

The research presents a well-defined and structured review methodology in respect of Libya based both domestic and international oil companies (prevention, surveillance, communications, result, resources, and HSE management and enhancement) that uses review ranking and grades points – this providing a validated review of HSE management performance. It is therefore felt that the aim and objectives of this thesis, originally stated as developing and validating a structured review methodology for health safety and environment management performance in Libya, have been reasonably achieved.

Moreover, the oil and gas industry specific and related problems are answered through an in-depth investigation of research objectives as discussed in the sections below.

Objective 1: To carry out an extensive literature review on best practice HSE Protection Performance Management.

Relevant and focused literature from several disciplines and fields of study, associated with the issues of performance measurement and state of HSE management within Libya based both domestic and international oil companies is presented has been carried out. The main HSE management standards and systems, rules, norms, regulation, and international bodies like UN declarations, conventions etc., the ways and associated benefits of integrating HSE, and HSE management auditing procedures are, critically assessed and reviewed. Chapter 2 concludes with summary of the occupational HSE aspects and sub-aspects mentioned in the past studies related to OHS and HSE. Therefore, it can be concluded that this first objective is accomplished and achieved to a large extent.

Objective 2: To carry out a critique on HSE Protection Performance Management in the Libyan oil and gas industry.

Syntheses of HSE problems in Libya based both domestic and international oil companies, and a discussion of synthesis of problems, is discussed in Chapter 3. The state of HSE in Libyan domestic and international oil companies in the industry's potential development and essential role in the country's economy are highlighted. The chapter also classifies Libyan domestic and international oil companies into upstream, midstream and downstream area groups, and the role of authorities in each class is shown. A summary of the role of NOC and EGA in promoting and supporting improved HSE performance is documented. This demonstrates that the second objective is also achieved to a large extent.

Objectives 3, 4 and 5:

1. To carry out a pilot study to gain a first impression of the level of awareness and commitment to Health Safety and Environment (HSE) Management in the Libyan oil Industry - Stage 1 of empirical research, pilot study (Questionnaire).
2. To carry out empirical research assessing the nature and conditions of successful HSE Performance Management in the context of the oil and gas industry – Stage 2 of empirical research (Structured Interviews).
3. To identify critical HSE protection performance indicators in the Libyan oil and gas industry – Stage 3 of Empirical Research (Questionnaire).

This has been achieved by:

- Stage 1 of the empirical research, to carry out empirical research assessing the type, nature and kind of successful HSE management in the context of the Libyan domestic and international oil companies.
- Stage 2 of empirical research, to identify critical health safety and environment aspects, output, activities and performance indicators in Libyan domestic and international oil companies.
- Stage 3 of empirical research, conducted to establish the awareness, preparedness and commitment to HSE protection, and to assess the applicability of HSE aspects obtained from previous studies to the Libyan domestic and international oil companies.

A number of carefully selected professionals from stakeholder companies (supervisors of large, and medium companies, and HSE managers in large and medium Libyan domestic and international oil and gas companies) have been identified as having understanding, knowledge and quality experience in the HSE areas, and have been interviewed by questionnaire surveys in order to gain a deeper understanding and better insight into this area.

The data capturing was challenging and difficult, owing to the secrecy of operations of many Libyan domestic and international oil companies, as much of the information is not available to the public domain by directives and policy of the companies. However, the officials in the participating companies were highly cooperative, appreciative and supportive of the research, and did their best to facilitate the primary data collection and capturing process. If any major HSE aspect is not specifically mentioned, it is because of the strict constrains in sensitive data capturing in Libya.

The second type of primary data is focused on identifying the applicability to the Libyan domestic and international oil companies of the HSE aspects obtained from previous similar studies by adapting and adopting structured interview questions, and related to a range of topics (HSE activities, motivators of HSE, HSE management system, HSE external information sources, performance indicators, regulations, measures, and communications and continuous learning). Participating Libyan companies have been selected from a number of industrial areas including Tripoli, Sirt, Benghazi, Ras Lanuf, Mersa Berga and Zawia. The companies selected form a good representative, and purposive sample for the research. The respondents were cooperative in answering the relevant questions in a series of interviews, meetings and workshops recorded verbatim for further analysis. All the interviews, meetings and workshops were held over different periods of time, and the respondents had enough confidence in the interviewer and trusted the confidentiality assured. This was done mainly to keep respondents in a congenial, peaceful and comfortable environment as possible.

The second type of primary data for its analysis has been subjected to rigorous statistical analysis, including central tendency and variation analyses. This form of analysis led to the identification of the most commonly used HSE indicators within Libya based both domestic and international oil and gas companies of different sizes and types. 60 HSE indicators were selected as the most appropriate applicable and commonly used. Therefore it can be concluded with fair degree of confidence that the third objective is also accomplished. The 60 HSE indicators, as recognised and outlined in the main body of this thesis, are the most commonly used in the research company sample.

In the second stage, the key aim was to assess the critical importance of the 60 indicators identified from stage 2 in respect of performance review. A comprehensive questionnaire was designed to measure the relevance and criticality of these HSE indicators as rightly appreciated and perceived by the respondents. In order to achieve this, respondents were asked to rate each of the 60 HSE indicators as critical (1), important (2) or of minor importance (3).

The questionnaire was administered to the same sample of 84 supervisors and HSE managers from 35 Libyan domestic and international oil and gas companies in the secondary industrial areas in selected study areas. The questionnaire was reviewed, examined and pre-tested prior to administration for clarity and accuracy. From the analysis results, it became clear that some indicators were perceived as critical, a few as important. The use of the Variation Ratio and Index of Diversity has been used to narrow down the criticality further of the critical and important factors identified.

Finally, the critical indicators that are deemed to be meaningful, effective and useful for HSE authorities are summarised and grouped into six HSE aspects. Therefore, it can be inferred that the third, fourth and fifth objectives are accomplished to a good degree of confidence.

Objective 6: To develop a practical HSE performance review methodology based on the literature review and empirical research results.

The structure of the proposed HSE management performance review methodology is presented according to the data captured from the literature review and empirical research carried out. Furthermore, the methodology developed has been based on two approaches:

- The Subject Review Method as used by the Quality Assurance Agency for Higher Education (QAA) to describe the method and procedures for carrying out subject reviews in England and Northern Ireland during 2001.
- The Health Safety and Environment Performance Measurement Tool prepared for the Health and Safety Executive.

Lessons learned from both methods have been used to develop a HSE performance review method tailor-made for the needs and expectations needs of the Libyan domestic and international oil companies. The use of six HSE aspects has yielded a structured way of reviewing performance and thus, it can be safely inferred that the sixth objective has been reasonably achieved.

Objective 7: To validate the HSE performance review methodology by direct application to a number of selected companies and revise the methodology where appropriate.

Validation of the HSE performance review methodology has been based on its direct implementation in selected Libyan domestic and international oil companies.

The review visits were conducted by an experienced review team, consisting of four specialist reviewers, and a seasoned review coordinator. Reviewers have been trained to gain a clear knowledge, understanding and knowhow of the review process. The majority of reviewers arrived at a consensus leading to an overall conclusion, based on their interviews, review visits and an analysis of the self-assessment, together with additional data provided.

Slight amendments, changes and modifications have been made to the first version of the HSE performance management performance review methodology. The feedback and highlights of experiential learning received from the health safety and environment experts involved in the review methodology validation, other HSE experts' feedback, and the observations made by the researcher and review team during the validation, formed as a basis to analyse, evaluate, interpret and revise the first version of the health safety and environment management performance review methodology.

Early indicators derived from the representative sample (5) of companies used in the validation process are very encouraging and go a long way to show that the framework can readily be used in practice.

Objective 8: To propose an associated implementation plan in Libya.

The proposed framework as a process is included to provide the general and overall requirements for its successful implementation. It is based on the logical reasoning and experiential learning. A proposed plan for implementing for the proposed health safety and environment management performance review methodology is presented. The concept, principles, opinions and ideas for this have been generated from the various lessons learned from the implementation of similar systems such as the Quality Assurance Agency's Subject Review (Brown, 2004).

The implementation plan of the HSE management performance review methodology is subdivided into four categories (planning, development, implementation and sustainability). Therefore, it can be inferred that the eighth objective has been achieved.

Objective 9: To provide conclusions and recommendations for further work.

Critical findings and conclusions from the research have been discussed in this thesis. Relevant recommendations for further work have also been outlined. Therefore it can be inferred that the ninth objective has been achieved.

8.1.3 Limitations of research

The present research is equally constrained and is a subject to a number of limitations. However, every care has been exercised to adequately structure the research so that constraining limitations and assumptions would not affect the targeted contributions. Firstly, HSE management performance is an area of research where theory is still in infancy and requires further work. It can be reasonably argued that despite the extensive literature review and empirical research carried out, it would not possible to claim that the work done is complete.

Secondly, relevant data capture in this field is far from straight forward, and is largely so owing to the secrecy of operations of many Libyan domestic and international oil companies. However, the officials are highly convinced, appreciative and supportive of the research and did their best to facilitate the primary data collection.

Thirdly, the cost and timeframe of the project are also constraints. Given the limited time available a complete investigation of all the HSE aspects of such a crucial oil sector contributing to 97% of country GDP especially with structured interviews could not be carried out and undertaken in totality. Though all possible efforts have been made to examine, interview and seek opinions of as many stakeholders s possible. As it happens and rather unfortunately, each company allowed a maximum of four interviews.

Fourthly, it is understood that some respondents may have provided answers more akin to what the interviewer wanted to hear. Having said this, the survey aimed to ask specific questions to ensure that responses given are relevant, specific and validated. Furthermore, when cross checking data across the various levels of investigation was carried out in order to reduce outliers.

Fifthly, the HSE management performance review methodology proposed in this research is ideally aimed to assist Libyan domestic and international oil companies of different sizes and types to help achieve a competitive position that embark on it while keeping in mind the information surrounding their efforts as private. Revealing information about how the HSE management performance review methodology is validated may lead to disclosure of some company specific practices. Consequently, the HSE management performance review methodology is dealt with as a very sensitive issue. Clearly, many companies will readily show unwillingness to participate in such studies that seek information about reviewing HSE management performance experiences. Others, while accepting to participate in the research, may remain hesitant to reveal hidden and unreported information. This, undoubtedly, can have an effect on the accuracy of the data captured.

Despite all the constraints discussed above, sufficient confidence has been obtained during the validation of the proposed methodology. It was evident from the respondents that such methodology will go a long way to enhance HSE in the Libyan oil and gas industries.

8.2 Conclusions

The following research findings and broad conclusions are drawn based on the review of literature, comprehensive HSE studies, assumptions and limitations of this investigation:

1. The search for Libyan oil has clearly moved into a world that is very challenging. The Libyan economy is heavily dependent on oil. The private sector has made considerable efforts to promote health safety and environment through voluntary programmers and cost reduction initiatives to optimize the return on investment such as product stewardship and the oil and gas industry's Responsible Care Programmed; non-governmental public health and environmental organizations, and trade unions. Other civil society organizations have made important contributions to the promotion of safety. Progress in management and efficiency enhancement has not, however, been sufficient and the environment nationwide continues to suffer from air, water and land contamination, impairing the health and welfare of Libyans. The need to take concerted action is accentuated by a wide range of Exploration and production technologies and processing safety concerns at the international level. This includes a lack of capacity for managing hazards, dependency on oil field safety, exposure of workers to harmful oil Fields and concern about the long-term effects of on both human health and the environment.
2. The national production, trade and use of oil and gas are increasing, with growth patterns placing an increasing Exploration and production waste management burden on the country, and presenting it with special difficulties

in meeting this challenge. As a result, fundamental changes are needed in the way that Libyan society manages Exploration and production waste management, efficiency improvement and profit maximization. A great deal needs to be done in this respect. A lot has been said in many international and national for but the country responsible organizations like NOC and EGA have not done enough. Most of the crisis in the country especially in areas where the oil is being explored and refined is in problem of socio-economic dimension and educationally backward with little or no any social security or compensation from the multi national's oil companies. Several accidents have already happened and include Gargoza in Tripoli polluted by oil pipeline leakage, El-Gezera polluted by petroleum from several oil tanks from last 30 years, Al-Howari near benzene station incident, El-Coefia near asphalt factory show polluted oils degraded domestic plants and contaminated groundwater by oil hydrocarbons in Benghazi. Results show that there are widespread profound impacts due to ground water pollution, oil contamination and bio-degradation. For example in Benghazi area there is degradation in case of Graminnea - grass plans, “Lupinus albus”, and “Salix Lasiolepis” in situations whenever the presence of 1.0% total petroleum hydrocarbons (TPH) is found. Oil remediation for such areas require expensive technologies like in situ oxidation, oil vapour extraction, bio-remediation like, rhizos-spheric microorganisms, etc.

3. There is an urgent need for the multinational companies such BP, Shell, Chevron, Oxy, and Resole who are beneficiaries from Libyan oil to establish an International world class Institute of petroleum with a full state-of-the-art equipped laboratories, educational facilities for Libyans to benefit from. Also Libya need to be as a partner with symbiotic relationship not exploitation or imperialistic partnership where the owners of the wealth are left behind and the developed world continues to be developed leaving Libya with their destiny of chance and not destiny of choice. The Libyan oil and gas resource is under developed, with little or no infrastructure, low or no health facilities, low education, no research materials and poverty is the order of the day – all this while Libyan have the natural endowment. A lot needs to done.

4. The empirical findings based on experiential learning conclude that a structured review methodology for health safety and environment management performance in Libya needs to begin with a trusted cooperative and collaborative relationship between the oil sector industries and the responsible authorities. The latter need to be treated as coach's not just judges, and must focus on the outcomes of HSE system in terms of enhancing HSE performance to reduce injuries, safeguard property and save lives. The authorities are in need of top-to-bottom reform. They must know a safety culture must be led from the top, and permeate at all levels including bottom shop floor level of operating companies in Libya. They need to assume an effective and central role in promoting and supporting all stages of the implementation phase, not merely at the beginning.
5. Based on data analysis, the research results demonstrate that most oil companies in Libya do not have an organized HSE management for measuring performance. It is hoped that the proposed review methodology if implemented would be of great significance in helping them to evolve an organized and structured way to manage HSE in workplaces and sites. This is amply evident from the reception, enthusiasm and willingness of the operating domestic and international companies during the empirical and validation phases of the research.
6. Only a very few of the companies engaged in upstream, midstream and downstream industries areas group sampled, especially SMEs, do not appear to have an effective and appropriate management system or programme related to HSE. Nearly half of them are found to be mostly working with quality management systems, which requires them to use a structured approach in monitoring and measuring performance based on Quality aspects. It is inferred; therefore, that once they become familiar with the proposed review methodology, they will hit the ground running since it is based on almost the similar principles.
7. It is interesting to find that complying with regulations is widely and rightly seen by the majority of respondents as the most important incentive for them to adhere to any HSE management system. Most of the interviewees expressed their views and opinions and openly admitted that regulations do influence

their approach to HSE matters, even more so than increased insurance premiums. This means that the oil sector authorities can help provide that vital indication much needed for making HSE management a reality in oil and gas industry in Libya. SMEs too responded in almost the same way as large companies. It appears that realization of personal liability with the ethical moral dimension does provide a powerful motivation mix for oil and gas industry to manage HSE in an improved manner. It is felt that since the six aspects of the review methodology are evolved using empirical research meaning the likelihood of adoption of the methodology is high, as it directly reflects experience in the oil fields.

8. Two out of six industrial areas, Tripoli and Marsa el Brega, have been chosen and selected by purposive sampling. The reasons for not using all six in the study were budget coupled with the usual difficulties in collecting data in Libya which is a large desert oil producing country with numerous domestic and international oil companies located almost in all parts of the country. The sample selected are adequate and yield valid results in terms of the empirical study, since it represents the single largest oil and gas sector industrial areas that contribute to around 85% of the entire Libya economy.
9. The process used to gather information from the triangulation research methodology is highly reliable and capable of providing a near true representation of how the respondents feel about and perceived HSE in oil and gas industry in Libya. All the 84 interviews are carried out in a relaxed and congenial atmosphere, with a view to encourage the respondents too freely, frankly and openly express their views, ideas, opinions and suggestions about the key issues. It is hoped that the six aspects of the review methodology based on the views, opinions, beliefs and conceptions of the practitioners is capable to help provide a logical and rational checklist for measuring, mapping, modelling and monitoring all that is related to HSE. This is equally verified from the view of the auditors after the review period.
10. Similar to the finding of earlier researches such as SPASE (Harms Ringdahl et al., 2000), and (Al-Qahtani, 2007) which stipulate the important role of the Authorities to provide support and key sources of information, this research, reveals that Libyan based companies found useful resources other than those

from the Authorities. This is a wasted opportunity, one that can be quickly resolved now by using the proposed review methodology. This is true particularly since a significant number of digital assets can be readily provided by the Authorities to help oil and gas sector review previous audit reports and associated grading, good practice examples, training blue prints, and good examples of how to score high on the various aspects. NOC and EGA need to provide definitive one-stop-shop for all issues surrounding HSE in an easy retrievable format in order to facilitate the review process, enhance cross organizational learning, and promote an efficient HSE protection culture in the country. Examples of these include: National capacity self-assessment of United Nations and World Bank supported project in Libya for system level, institutional level and individual level improvement. This includes focusing on improving inspection system/activities, encouraging self-evaluation in organizations, encouraging informal interaction between authorities and organizations, and focusing on positive incentives as ways for improving the monitoring system.

11. The feedback received, particularly during the validation phase, confirmed that the proposed HSE management performance review methodology is capable of providing a range of benefits that are both direct (tangible) and indirect (intangible) in nature. In brief, it is evident that by adhering to the various levels of validation of the review methodology makes oil and gas companies in a position to derive significant benefits. In addition the decision-making process and the flow of information are transparent, leading to improved corporate learning in an efficient and effective way.
12. The proposed review methodology for health safety and environment management in Libya is capable of serving as a self-assessment tool which oil companies may use in their internal audits to track performance successfully and priorities corrective actions and remedial measures.
13. The present research has required a serious effort to review current HSE management performance in oil sector of Libya. The successful validation of the proposed health safety and environment protection performance review methodology at five different companies provides sufficient confidence in the structure and associated grading to judge HSE management performance in

respect of oil sector in Libya. Early indications from both the NOC Authorities and EGA suggest that the methodology developed is certainly a step in the right direction. The details of the methodology may change with time in terms of the exact definitions of aspects and sub-aspects, but the main concept of 6 areas highlighting the life cycle process and the associated grading provides a promising start, according to senior managers from the Environmental General Authorities and NOC.

14. This research has recognized a series of barriers and impediments for implementation that must be carefully considered to ensure successful reviewing of HSE management performance. These barriers and impediments are taken into consideration in the proposed implementation plan. Future research needs to focus on the merits of various approaches for doing this. However, at the present moment, senior managers from the both NOC and EGA Authorities and the oil sector segment consulted agree that an intensive awareness and preparedness campaign focusing on greater support from the NOC and EGA Authorities plus a pilot phase to learn from a wider test would enhance the chances of success of the review methodology. The critical success factors include trust making, trust building and trust keeping between the parties, fairness of the approach, and transparency on all sides.
15. One of the most direct outcomes of the present research is the fact that Libyan oil Industries no longer has to rely on proxy experience and case law to manage their HSE. Instead, they need to rely more on a structured and consistent tool that could help identify strengths and weaknesses to further improve HSE management. The idea of making audit reports publicly available should help provide sufficient steer for companies to take the whole discipline more seriously and, at the same time, help provide opportunities for all to do better.

8.3 Recommendations for further research

It is believed that this research essentially constitutes the first Libyan study that explores HSE in domestic and international oil and gas industries which accounts for 95% of the Libyan market share.

Whilst the results of this first of its kind study are encouraging, it is important that further research needs to be planned and executed to expand the findings from this research as follows:

1) The HSE Performance Review methodology needs to be tested more widely in the oil and gas sectors of Libya in close collaboration with the NOC and external agencies.
2) Targeted training material would need to be developed for peer reviewers to focus all efforts on transparency. The training material would include where and how to look for poor HSE performance and how to report it.
3) A benchmarking research needs to be carried out to expose good practice and harvest it in an easily accessible system for wider dissemination.
4) More research is needed to prune down the effort required for conducting review visits by encouraging companies to submit even more evidenced information about their HSE systems with the view to only visit when absolutely necessary – especially in the first round of deploying the proposed methodology.
5) A dedicated secure web-browser based decision support could be developed to capture and report HSE performance in real-time. The same system could be used for providing a ready-made lessons learned system.
6) The validity of the performance review methodology needs to be tested in other industries where HSE is prominent, for example, manufacturing and shipbuilding.

8.4 Recommendations for further work in Libya

In respect of, and as part of the work done for developing and testing the HSE Performance Review Methodology, Libya has a long way to go and needs to minimally do the following:

- Maximize activities; including green jobs creation with enhanced competence assured quality, for improved standards of living, public health and protection of the environment, and need to continue working together to promote the safe production and use of oil and gas.

- Strengthen the capacities of all concerned to achieve the sound management intellectual capital, exploration and production waste minimisation, sound management of oil fields and hazardous wastes at all levels.
- Mobilize national and international financing from public and private sources for the life-cycle management of oil and gas activities and oil fields.
- Work towards closing the gaps and addressing the discrepancies in the capacity to achieve sustainable exploration and production activities and oil fields management by addressing the special needs of the country and strengthening its capacities for the sound management of activities, the development of safer alternative products and processes, including non-chemical alternatives, through partnerships, technical support.
- Work towards effective and efficient governance of exploration and production data and oil fields production and safety management by means of transparency, public participation and accountability involving all sectors of society, in particular striving for the equal participation of women in exploration and production management.
- Engage actively in partnerships between Governments, the private sector and civil society, including strengthening participation in the implementation of the Strategic Approach by medium and large-size enterprises.
- Stress the responsibility of oil and gas industry to make available to stakeholders such data and information on HSE effects of exploration and production and oil fields as are needed safely to use the products made from them.
- Facilitate public access to appropriate information and knowledge on exploration and production and associated wastes and oil fields throughout their life cycle, including the risks that they pose to human health .
- Ensure that, when information is made available, confidential commercial and industrial information and knowledge are protected in accordance with national laws or regulations or, in the absence of such laws and regulations are protected in accordance with international provisions. In making information

available, information on oil field relating to the health and safety of humans and the environment should not be regarded as confidential.

- Recognize the need to make special efforts to protect those groups in society that are particularly vulnerable to risks from hazardous oil field or are highly exposed to them.
- Protect children and the unborn child from waste exposures that impair their future lives.
- Endeavour to prevent illegal traffic in toxic, hazardous, banned and severely restricted exploration and production wastes and oil fields products.
- Promote the sound management of Exploration and production activities manufacturing and associated waste and oil field hazardous waste as a priority in national policy frameworks, including strategies for sustainable development.
- Strive to integrate the Strategic Approach into the work programmes of all relevant United Nations organisations, specialised agencies, funds and programmes consistent with their mandates as accorded by their respective governing bodies.
- Understand and acknowledge that as a new voluntary initiative in the field of international management of oil fields, the Strategic Approach is not a legally binding instrument; Libya must collectively share the view that implementation and taking stock of progress that are critical to ensuring success and that, in this regard, a stable and long-term fully participatory and multispectral structure for guidance, review and operational support is essential.

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Appendices

Appendix A: Definitions of key terms

ANSI – American National Standard Institute, non-profits, voluntary membership organization that coordinates the U.S. Voluntary Consensus Standards System. Their standards have been adopted throughout government and industry for various types of personal protective equipment.

Hazard assessment –The investigation of the work environment for potential dangers that could result in an injury or illness.

Material safety data sheet (MSDS) – A document describing the hazards and safe handling practices for a specific product.

Personal protective equipment (PPE) – Equipment worn by workers to protect against hazards in the environment. Examples include safety glasses, face shields, respirators, gloves, hard hats, steel-toed shoes, and hearing protection.

Biological Oxygen Demand (**BOD)**: the rate of wastewater pollution expressed by the amount of oxygen required by microorganisms for the biological oxidation of organic waste in a unit volume of waste water.

Declaration of conformity (DOC): the process by which businesses and subsidiaries of case study company declares the level of compliance with HSE Management System based on conducted self-assessments and audits.

Flared and vented gas:

Flaring is burning of gases in a thermal destruction device and includes also the flaring of associated gas from oil production.

Venting is the controlled release of gases in the atmosphere. The gases might be natural gas or other hydrocarbon vapours, water vapour and other gases, such as carbon dioxide, separated in the processing of oil or natural gas.

Filling Station (FS)

Full-time employee (FTE)

Greenhouse gases (GHG): gases that contribute to the formation of an undesirable insulating blanket around the Earth by trapping heat from infrared radiation (CO2, CH4, N2O, HFC, PFC, SF6).

Global reporting initiative (GRI): a multi-stakeholder process and independent institution whose mission is to develop and disseminate globally applicable Sustainability Reporting Guidelines.

Health, safety and environment (HSE)

Incident inquiry rate: number of HSE incidents inquired by root cause analyses (TRIPOD approach) per number of all HSE incidents.

Lost time injury frequency (LTIF): the number of incidents of lost time injury (LTI) per one million hours worked.

Road accident rate (RAR): the number of road accidents per 1 million km driven.

Remediation: preventing, minimizing, remedying or mitigating the effects of pollution in relation to contaminated land or water, or restoring such land or water to its former state.

Total petroleum hydrocarbons (TPH): oil substances, a parameter expressing the pollution of surface water by organic oil substances.

Vapour recovery unit (VRU)

Work-related injury: any form of injury or death incurred by an employee independent of his or her own will by a temporary, sudden or violent external factor while carrying out work duties or in direct relation to those duties.

Caught between: Injury where injured person is crushed or similarly injured between machinery moving parts or other objects caught between rolling tubular or objects being moved crushed between a ship and a dock or similar incidents.

Company employee: Any person employed by and on the payroll of the reporting Company, including corporate and management personnel specifically involved in exploration and production. Persons employed under short-service contracts are included as Company employees provided they are paid directly by the Company.

Construction: Major construction, fabrication activities and also disassembly, removal and disposal (decommissioning) at the end of the facility life. Includes construction of process plant, Yard construction of structures offshore installation hook up and commissioning and removal of redundant process facilities.

Contractor: A 'Contractor' is defined as an individual or organization performing work for the reporting company, following verbal or written agreement. 'Sub-contractor' is synonymous with 'Contractor'.

Contractor employee: Any person employed by a Contractor or Contractor's Subcontractor(s) who is directly involved in execution of prescribed work under a contract with the reporting Company.

Drilling: All exploration appraisal and production drilling and work over as well as their administrative engineering construction materials supply and transportation aspects. It includes site preparation, rigging up and down and restoration of the drilling site upon work completion.

Exploration Geophysical, seismographic and geological operations, including their administrative and engineering aspects, construction, maintenance, materials supply, and transportation of personnel and equipment; excludes drilling.

Fall Incident caused by falling off, over or onto something.

Fatal accident rate (FAR): The number of fatalities per 100,000,000 (100 million) man-hours worked.

First aid case: Cases that is not sufficiently serious to be reported as medical treatment or more serious cases but nevertheless require minor first aid treatment, e.g. dressing on a minor cut, removal of a splinter from a finger. First aid cases are not recordable incidents.

Hours worked: the actual 'hours worked', including overtime hours, are recorded in the case of onshore operations. The hours worked by an individual will generally be about 2,000 per year. For offshore workers, the 'hours worked' are calculated on a 12-hour work day. Consequently average man hours worked per year will vary from 1,600 to 2,300 hours per person depending upon the on/off shift ratio. Vacations and leaves are excluded.

Hours worked in year (000's): Hours worked must be reported in multiples of one thousand and should be rounded to the nearest thousand.

Lost time injury (LTI): a fatality or lost work day case. The number of LTIs is the sum of fatalities and lost work day cases.

Lost time injury frequency (LTIF): The number of lost time injuries (fatalities + lost work day cases) per 1,000,000 man hours worked.

Lost work day case (LWDC): Any work-related injury or illness, other than a fatal injury, which results in a person being unfit for work on any day after the day of occurrence of the occupational injury. 'Any day' includes rest days, weekend days, leave days, public holidays or days after ceasing employment.

Medical Cause of Death: This is the cause of death given on the death certificate. Where two types of causes are provided, such as 'pulmonary edema' caused by 'inhalation of hot gases from a fire', both are recorded.

Number of lost workdays: The sum total of calendar days (consecutive or otherwise) after the days on which the occupational injuries occurred, where the persons involved were unfit for work and did not work.

Number of employees: Average number of full-time and part-time employees involved in exploration and production, calculated on a fulltime basis, during the reporting year.

Number of fatalities: The total number of Company's employees and/or Contractor's employees who died as a result of an incident. 'Delayed' deaths that occur after the incident are to be included if the deaths were a direct result of the incident. For example, if a fire or explore killed one person outright, and a second died twenty days later from lung damage caused by the fire, both are reported. In some cases, a delayed fatality occurs in the next calendar year after the incident. For example, if the above fire occurred on December 30, 2009, the second death from it might occur in first January 2010. All fatalities from an incident are included in the report for the year of that incident. In the above case, the fatality in 2010 is reported with the 2009 data.

Occupational illness: Any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. Occupational illness may be caused by inhalation, absorption, ingestion of, or direct contact with the hazard, as well as exposure to physical and psychological hazards. Occupational Injury: Any injury such as a cut, fracture, sprain, amputation, etc, which results from a work-related activity or from an exposure involving a single incident in the work environment, such as deafness from explosion,

Offshore work: All activities and operations that take place at sea, including activities in bays, in major inland seas, or in other inland seas directly connected to oceans. Incidents including transportation of people and equipment from shore to the offshore location, either by vessel or helicopter, should be recorded as 'offshore'.

Onshore work: All activities and operations that take place within a landmass, including those on swamps, rivers and lakes. Land-to land aircraft operations are counted as onshore, even though flights are over water.

Production petroleum and natural gas producing operations, including their administrative and engineering aspects, minor construction, repairs, maintenance and servicing, materials supply, and transportation of personnel and equipment. It covers all mainstream production operations including wire-line. Gas processing activities with the primary intent of producing gas liquids for sale including: • secondary liquid separation (i.e. Liquid Natural Gas [LNG] extraction using refrigeration processing) • Liquefied Natural Gas (LNG) and Gas to Liquids (GTL) operations

Restricted work day case (RWDC): Any work-related injury other than a fatality or lost work day case which results in a person being unfit for full performance of the regular job on any day after the occupational injury. Work performed might be:

- An assignment to a temporary job
- Part-time work at the regular job
- Working full-time in the regular job but not performing all the usual duties of the job. Where no meaningful restricted work is being performed, the incident should be recorded as a lost work day case (LWDC).

Third party: A person with no business relation with the company or contractor.

Vehicle incident: Incidents involving motorized vehicles designed for transporting people and goods over land, e.g. cars, buses, trucks. Pedestrians struck by a vehicle are classified as vehicle incidents. Incidents from a mobile crane would only be vehicle incidents if the crane were being moved between locations.

Best available evidence: Conclusive evidence of the links between, for example, socio-environmental factors and health or the effectiveness of interventions is not always available. In such cases the best available evidence – that which is judged to be the most reliable and compelling – can be used, but with caution.

Community Participation: Involving the community in an activity such as the planning of projects or carrying out a HIA. There are a number of models of community participation, some of which are outlined in the Gothenburg consensus paper on HIA (WHO, 1999). Comprehensive (maxi) HIA.

Concurrent HIA: Concurrent HIA is carried out while a policy, program or project is being implemented.

Cost-effectiveness analysis: Systematic comparison of the relative value of different interventions for producing desired effects (i.e. better health and/or longer life, where the denominator reflects the expected gain (e.g. deaths-prevented, quality-adjusted life-years (QALYs) or numbers of individuals meeting health recommendations) and the numerator expresses the expected cost of the intervention (Gold et al., 1996).

Determinants of health: Determinants of health are factors which influence health status and determine health differentials or health inequalities. They include biological factors (e.g. age, gender and ethnicity), behaviour and lifestyles (e.g. smoking, alcohol consumption, diet and physical activity), physical and social environment (e.g. housing quality, workplace stressors, and air pollution), and access to health care. (Labonté 1993) All of these are closely interlinked and differentials in their distribution lead to health inequalities.

Economic impact assessment: Economic impact assessment involves exploring and identifying the ways in which the economy in general or local economic circumstances in particular, will be affected by a policy, program or project.

Environmental impact assessment: Environmental impact assessment (EIA) is a well-developed discipline, both in terms of theory and practice, having been in operation for nearly 30 years in the United States. Its origins lie in the U.S. National Environmental Policy Act of 1969 (NEPA). In the same way that HIA explores the health effects of policies, programs and projects on health, EIA does the same in terms of environmental effects. Some states have their own statutes, such as California's Environmental Quality Act (CEQA) governing environmental impact assessment. Because they are often subject to numerous mandates and legal challenge, EIAs are often long, complex documents that may take years and millions of dollars to complete.

Equity in health inequity – as opposed to inequality – has a moral and ethical dimension, resulting from avoidable and unjust differentials in health status. Equity in health implies that ideally everyone should have a fair opportunity to attain their full health potential and, more pragmatically, that no one should be disadvantaged from achieving this potential if it can be avoided. (WHO EURO, 1985) More succinctly, Equity is concerned with creating equal opportunities for health and with bringing health differentials down to the lowest possible level. (Whitehead, 1990).

Evidence base: The evidence base refers to a body of information, drawn from routine statistical analyses, published studies and "grey" literature, which tells us something about what is already known about factors affecting health. For example, in the field of housing and health there are a number of studies which demonstrate the links between damp and cold housing and respiratory disease and, increasingly, the links between high quality housing and quality of life (Thomson et al., 2001).

Health impact: can be positive or negative. A positive health impact is an effect which contributes to good health or to improving health. For example, having a sense of control over one's life and having choices is known to have a beneficial effect on mental health and wellbeing, making people feel "healthier" (Wilkinson, 1996). A negative health impact has the opposite effect, causing or contributing to ill health. For example, working in unhygienic or unsafe conditions or spending a lot of time in an area with poor air quality is likely to have an adverse effect on physical health status.

Health impact assessment: (HIA) is most often defined as "a combination of procedures, methods and tools by which a policy, program or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population (World Health Organization, 1999). This broad definition from the World Health Organization European Centre for Health Policy (ECHP) and presented in the Gothenburg Consensus paper on HIA reflects the many variants of HIA. A somewhat more precise definition is that HIA is "a multidisciplinary process within which a range of evidence about the health effects of a proposal is considered in a structured framework, based on a broad model of health which proposes that economic, political, social, psychological, and environmental factors determine population health" (Northern and York Public Health Observatory, 2004).

Health inequality and inequity: Health inequalities can be defined as differences in health status or in the distribution of health determinants between different population groups. For example, differences in mobility between elderly people and younger populations or differences in mortality rates between people from different social classes. It is important to distinguish between inequality in health and inequity.

Healthy public policy: Healthy public policy is a key component of the Ottawa Charter for Health Promotion (1986). The concept includes policies designed specifically to promote health (for example banning cigarette advertising) and policies not dealing directly with health but acknowledged to have a health impact (for example transport, education, economics) (Lock, 2000).

Impact assessment: is about judging the effect that a policy or activity will have on people or places. It has been defined as the "prediction or estimation of the consequences of a current or proposed action" (Bronstein, 1995)

Integrated impact assessment: brings together components of environmental, health, social and other forms of impact assessment in an attempt to incorporate an exploration of all the different ways in which policies, programs or projects may affect the physical, social and economic environment. New Zealand and Australia have particularly noteworthy examples of integrating HIA into existing EIA processes.

Intermediate HIA monitoring and evaluation: An intermediate HIA may combine a workshop with key stakeholders followed by desk-based work to build up a more detailed picture of the potential health impacts than those which would be identified during a rapid or "mini" HIA. It may involve a limited literature search, usually non-systematic, and is mostly reliant on routine, readily available data (Parry and Stevens, 2001).

Monitoring and evaluation: Monitoring is the process of keeping track of events. For example, the monitoring of a project may involve counting the number of people coming into contact with it over a period of time or recording the way in which the project is administered and developed. Evaluation involves making a judgment as to how successful (or otherwise) a project has been, with success commonly being measured as the extent to which the project has met its original objectives.

Neighbourhood: The term neighbourhood usually refers to a local area which is defined in some way physically (for example, an estate or an area bounded by major roads) or by people's perceptions of what constitutes their local area. Neighbourhoods are usually fairly small. For example, neighbourhoods designated for New Deal for Communities funding are usually made up of around 4,000 households or around 10,000 people.

Outcomes: The effect the process has had on the people targeted by it. These might include, for example, changes in their self-perceived health status or changes in the distribution of health determinants, or factors, which are known to affect their health, well-being and quality of life.

Outputs: The products or results of the process. These might include, for example, how many people a project has affected, their ages and ethnic groups or the number of meetings held and the ways in which the findings of the project are disseminated.

Policy: A policy can be defined as an agreement or consensus on a range of issues, goals and objectives which need to be addressed (Ritsatakis et al., 2000). For example, “Saving Lives: Our Healthier Nation” can be seen as a national health policy aimed at improving the health of the population of Libya, reducing health inequalities and setting objectives and targets which can be used to monitor progress towards the policy’s overall goal or aim.

Program: The term program usually refers to a group of activities which are designed to be implemented in order to reach policy objectives (Ritsatakis et al., 2000). For example, many Single Regeneration Budget programs and New Deal for Communities initiatives have a range of themes within their program – often including health, community safety (crime), education, employment and housing – and within these themes are a number of specific projects which, together, make up the overall program.

Project: A project is usually a discrete piece of work addressing a single population group or health determinant, usually with a pre-set time limit. Usually (but not always), the term refers to “bricks and mortar” projects involving construction of a discrete structure or group of structures, such as a power plant, highway, or housing development.

Prospective HIA: is carried out before any action has been taken, either in terms of drafting a policy, putting together an action plan or implementing it so that steps can be taken, at the planning stage, to maximize the positive health impacts of a policy, program or project and to minimize the negative effects (Scott-Samuel et al., 1998).

Qualitative and quantitative: HIA tries to balance qualitative and quantitative evidence. It involves an evaluation of the quantitative, "scientific" evidence where it exists but also recognizes the importance of more qualitative information. This may include the opinions, experience and expectations of those people most directly affected by public policies and try to balance the various types of evidence (Barnes and Scott Samuel, 1999). Generally speaking, quantitative evidence is based on what can be counted or measured objectively whilst qualitative evidence cannot be measured in the usual ways and may more subjective, for example, encompassing people's perceptions, opinions and views.

Population health: The health of groups, families and communities, defined by locality, biological criteria (e.g. age, gender or health condition), or social criteria (e.g. socio-economic status or cultural affiliation). The population health approach, which provides a foundation for HIA, emphasizes health as a resource or capacity, not simply a state.

Retrospective HIA: Retrospective HIA is carried out after a program or project has been completed. It is used to inform the ongoing development of existing work.

Risk assessment (risk analysis): The quantitative approach to HIA incorporates many of the elements of risk assessment laid out in environmental impact assessment and engineering. The risk assessment paradigm prescribes a sequence for four steps for assessing risks: (1) hazard identification, (2) exposure assessment, (3) dose-response assessment, and (4) risk characterization (i.e. evaluation of impact of changing exposure levels. Usually, but not necessarily this process is quantitative.

Risk, attributable: The proportion of new events or cases in a given time period attributable to exposure to a risk factor (Cupper, Morgenstern 1982).

Relative risk (Risk Ratio): The ratio of the probability of an event occurring in an exposed group versus an unexposed group. A relative risk of 1 indicates that there is no difference in the two groups' risk of the event. A relative risk of 2 indicates that the exposed group has double the risk of the unexposed group.

Scoping: Scoping refers to the process of identifying the potential health impacts of a policy program or project before they are quantified as in a rapid HIA. It may include reviewing the relevant literature and evidence base and collecting the views of key stakeholders (those with expert knowledge of the project, those involved and those potentially affected) followed by the tabulation of the potential health impacts (Parry and Stevens, 2001).

Screening: In relation to HIA, screening usually refers to an initial step being taken in order to determine whether a policy, program or project should be subject to a HIA. The criteria used for this process may include, for example, the size and cost of the activity in question, the extent of any obvious or immediate health effects or the perceived extent of longer term effects.

Social impact assessment: is “the process of assessing or estimating, in advance, the social consequences that are likely to follow from specific policy actions or project development, particularly in the context of appropriate national, state or provisional policy legislation” (Bronstein, 1995). It is based on the assumption that the way in which the environment is structured can have a profound effect on people’s ability to interact socially with other people and to develop networks of support.

Strategic environmental assessment (SEA): SEA has been defined as “the environmental assessment of a strategic action: a policy, plan or program (Partidario, 1996). SEA developed out of the recognition that the environmental impact assessment of specific projects, whilst an extremely valuable device, does not allow sufficient scope for the examination of the effect of a combination of projects.

OGP: The International Association of Oil and Gas Producers encompasses the world’s leading private and state-owned oil and gas companies, their national and regional associations, and major upstream contractors and suppliers.

Definitions of terms related to exploration and production activities

Exploration covers geophysical, seismographic and geological activities, inclusive of administrative and engineering aspects, maintenance, materials supply, and transportation of personnel and equipment. Exploration drilling is to be included under ‘drilling’.

Drilling includes all exploration, appraisal and production drilling and work over as well as their administrative, engineering, construction, materials supply and transportation aspects. It includes site preparation, rigging up and down and restoration of the drilling site.

Production covers petroleum and natural gas production operations, including administrative and engineering aspects, repairs, maintenance and servicing, materials supply and transportation of personnel and equipment. It covers all mainstream production operations. Included are:

- Oil (including condensates) and gas extraction and separation (primary production).
- Heavy oil production where it is inseparable from upstream (i.e. steam assisted gravity drainage) Production.
- Primary oil processing (water separation, stabilization).
- Primary gas processing (dehydration, liquids separation, sweetening, CO2 removal).
- Gas processing activities with the primary intent of producing gas liquids for sale;
- Secondary liquid separation (i.e. Liquid Natural Gas [LNG] extraction using refrigeration processing).
- Liquefied Natural Gas (LNG) and Gas to Liquids (GTL) operations
- Excluded are:
- Production drilling or work over.
- Mining processes associated with the extraction of heavy oil tar sands.
- Heavy oil when separable from upstream operations.
- Secondary heavy oil processing (upgrade).
- Refineries.

Terms related to work-relatedness

An injury or illness: must be considered work-related if an event or exposure in the work environment caused or contributed to the resulting condition or significantly aggravated a pre-existing injury or illness. Work-relatedness is presumed for injuries and illnesses resulting from events or exposures occurring in the work environment unless one of the following exceptions applies in its entirety:

- Occurs when an employee or contractor is present in the work environment as a member of the general public. In case of a fatality, it will be included in the 3rd party statistics.
- Results solely from voluntary participation in a wellness program or in a medical, fitness, or recreational activity, such as blood donation, physical examination, flu vaccination, exercise class, racquetball, baseball etc. Where the activity is company-sponsored the participation must be perceived by the employee as voluntary for this exception to apply.
- Involves signs or symptoms that surface at work but result solely from a non-work-related event or exposure.
- Is solely the result of eating, drinking, or preparing food or drink for personal consumption (whether bought on the employer's premises or brought in). For example, if the employee is injured by choking on a sandwich while in the employer's establishment, the case would not be considered work-related.

Note: If the employee is made ill by ingesting food contaminated by workplace contaminants (such as lead), or gets food poisoning from food supplied by the employer, the case would be considered work-related.

- Is solely the result of doing personal tasks in the work environment outside of the employee's assigned working hours?
- Is solely the result of personal grooming, self-medication for a non-work-related condition or is intentionally self-inflicted.

Note: contagious diseases such as tuberculosis, brucellosis, hepatitis A, or plague are considered work-related if the employee is infected at work

- Occurs during a commute from the home to the normal place of work or first stop unless it is company-mandated transport.

Terms related to company work-related activities

All work by Company personnel, including attendance at courses, conferences and Company organized events where participation is perceived by the employee as mandatory, business travel, field visits or any other activity or presence expected by the employer. Refer to the section on work-relatedness for the exemptions that apply.

Terms related to incident classifications

Fatality – cases that involve one or more people who died as a result of a work-related incident or occupational illness. 'Delayed' deaths that occur after the incident are to be included if the deaths were a direct result of the incident. For example, if a fire killed one person outright, and a second died three weeks later from lung damage caused by the fire, both shall be reported. In some cases, a delayed fatality occurs in the next calendar year after the incident. For example, if the above fire occurred on December 28, 2008, the second death from it might occur in January first 2009. All fatalities from an incident are included in the report for the year of that incident. In the above case, the fatality in 2009 is reported with the 2008 data.

Lost work day case (LWDC) – non-fatal cases that involve a person being unfit to perform any work on any day after the occurrence of the occupational injury or illness. 'Any day' includes rest days, weekend days, leave days, public holidays.

Restricted work day case (RWDC) – cases that do not result in a fatality or a lost work day case but do result in a person being unfit for full performance of the regular job on any day after the occupational injury. Work performed might be:

- An assignment to a temporary job
- Part-time work at the regular job

Appendix B: Stage 1: Pilot study interview questions

1. Information about the oil ccompany related organization and responsibility.

Introduction

- Company name:
- Business name:
- Workplace Address:
- Industry:

2. How many people does your company employ?

- 101 to 200
- 201 to 500
- More than 500

3. What is your job title?

- Owner or senior director
- HSE coordinator
- Production Manager
- Safety Supervisor
- Other (please specify)……

4. What does your job focus on?

- Safety
- Health
- Environment

5. Who would be involved in any actions taken to reduce risks from potential hazards at your workplace?

- Myself (respondent)

- o Employee HSE representative
- o HSE committee
- o HSE safety manager
- o Supervisor

6. Reasons why you personally comply with the HSE regulations?

- o It's the law
- o Part of my responsibility
- o Part of my company policy
- o To protect HSE of workers
- o Fear of inspection
- o To comply with supply chain requirements
- o To minimize accident cost

7. Is there a designated HSE manager for the workplace?

- o Yes
- o No

8. Are you the person responsible for final decisions on HSE for your company?

- o Yes
- o No

I. The following is a list of statement about health safety and environment practices. I would like you to say how strongly you agree or disagree with each statement in your company?

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

1. Regulations and monitoring

- HSE requirements are fair
- HSE requirements are easy to implement
- My company only acts on HSE issues after an inspection
- Civil defence don't understand how regulations apply in our workplace
- Inspectors are a valuable source of advice and information about HSE regulations
- HSE requirements are very important in preventing workplace accidents
- HSE is just common sense
- The regulations provide the best information about HSE
- Threat of penalties encourages me to comply with HSE requirements
- If we don't comply with requirements, it is likely that we would be fined

16. Management responsibility and enhancement

- How responsibility shared, and how are the contributions of co-workers valued?
- I believe I would be personally liable for a workplace accident
- Enforcing safety first is a part of my business
- I am responsible for the safety of employee who working with me
- It is necessary for me to read the HSE regulations after serious workplace accidents
- Employee only pays attention to HSE after a serious workplace accident
- Employee is the best workers to provide suggestions about better workplace HSE practices

17. Safety performance achievement

a) Improving HSE procedures reduces injury-related lost time

b) HSE training prevents the need for re-skilling workers in case of injury

c) Improving HSE procedures reduces a lot of cost

d) Improving HSE procedures increases workers productivity

18. Awareness

a) It does not matter what safety procedures are implemented, workers will ignore them

b) It is easier to get HSE compliance from workers if there is a strong union presence

c) Strong top management support is the best way to make HSE changes

d) Some accidents are not preventable

e) Previous experience of a workplace accident makes workers work more safely aware.

19. Information resources

- I would only use a supplier if I could see their documented safety procedures e.g. ISO 18000
- If we did not have documented safely practices our distribution would not purchase our products
- We actively monitor the documented safety procedures of our subcontractors
- Insurers are one of the great source information for improving safely

20. Learning

- We would lose customers if our company had a highly workplace accident
- My safety file affects my personal reputation

II. The following list of statements about influences on workers regarding HSE.

I would like you to tell me how important each of them.

Extremely Important	Very Important	Important	Not Important	Don't know

21. **Compliance with regulations, inspection and standard**
    - HSE requirements set by government
    - HSE codes of practice
    - The advice given to your workplace by EGA inspectors
    - The threat of personally being prosecuted
22. **Learning and communications**
    - Poor publicity your company might receive after an accident.
    - Documented health and safety procedures for winning more business.
23. **Safety performance and reward**
    - Time and cost of legal defence if you are prosecuted
    - Threat of work being stopped because you don't meet safety standards lost time through workplace injuries
24. **Resources /intermediary pressure**
    - Contracts requiring specific HSE standards
    - Government resources
    - Difficulty of obtaining resources
    - Industry association guidelines

III. Do you have a system to document things to be done to reduce risks in the hazard workplace?

- Yes-All
- Yes-Most
- Yes-Some
- No

IV. The following is a list of sources which are used for obtaining information about HSE issues in the workplace. I would like you to tell me how useful each of them is for you.

Extremely useful 1	Very useful 2	Useful 3	Not useful 4	Don't know 5

- Workers in workplace
- HSE representatives in workplace HSE Committee in workplace
- HSE codes of practice
- Workers association
- Work cover/insurer publications
- Risk management consultant
- Other people in the industry
- Trade magazine/journal
- Internet and e-mail
- Training courses and seminars

V. When does your company review existing risk assessment?

- Regularly (e.g. every 2 or 4years)
- Change in work conditions
- Change in standards and regulation etc.
- After a big accident
- After monitoring result
- Not at all

Thank you for your co-operation for answering these questions

Appendix C: Stage 2: Interview questionnaire

The main objectives of the interview study are:

- To establish the awareness and commitment to health safety and environment of the companies from key individual's influential within the work.
- To assess the applicability to Libyan oil industries companies of health safety and environment issues and aspects, which have been found from pilot study.

We will be asking a range of questions about a particular approach to and experience of H S and E. The questions we will be asking will relate to the following issues:

- HSE activities
- Motivators of HSE
- HSE management system.
- HSE external information sources.
- Performance measures.
- Communications, continuous learning and capacity development.
- Other areas focused upon Health Safety and Environment (HSE) issues.

To cover all of these areas, we have formulated a series of questions, please response as appropriate.

1. Is HSE an important issue to be managed by your company?
   a. Yes
   b. No
   c. No idea
2. Which of the following would be the most important for your company to manage health safety and Environment enhancement?
   a. HSE policy
   b. HSE manual and procedure
   c. HSE committees
   d. HSE prizes/rewards
   e. HSE training for newly-hired employees (orientation)
   f. HSE targets and objectives

3. Which of the following would be the most important for your company to control health safety and Environment risk?
    a. Job analysis in terms of HSE
    b. Risk assessment
    c. Emergency planning
    d. Personal protective equipment (PPE)
    e. Security system
    f. Medical examination of employees
    g. Oil and gas handling
    h. Ventilation system
4. Which of the following would be the most important for your company to evaluate health safety and Environment performance?
    a. Accident record and investigation
    b. Near miss (incident) record
    c. Inspection and housekeeping
    d. Attitude / preparation surveys
    e. EIA and EIS
    f. HSE audits/housekeeping audits
    g. Financial losses (damage cost evaluation)
5. Which of the following aspects influence the effectiveness of your company's activities in HSE?
    a. HSE awareness
    b. Leadership commitment
    c. Supervisor and line management commitment
    d. Workers behaviour and participation
    e. System of recognition and rewards
    f. Documentation and data control
    g. Positive HSE culture
    h. Internal communication
    i. Workers training
    j. Supervisor and line management training
    k. Financial resource
    l. Performance evaluation

6. Which of the following would be the most important motivators for your company to be active in the field of HSE?
    a. Complying with regulations
    b. Expensive cost of accident/ill health
    c. Providing safe work place for all the worker
    d. Caring and sharing
    e. Publicity/images
    f. Recent accidents
    g. Pressure from authorities
    h. Pressure from staff
    i. Meeting insurer expectations
    j. Minimizing insurance cost
    k. Meeting trade/international trade requirements
    l. Satisfying stakeholders
    m. Satisfying society
    n. Satisfying interest groups
7. Which of the following would be considered important reasons for you or your company when implementing HSE management standards?
    a. Good management procedures
    b. Competitive advantage
    c. Trade and international trade
    d. Required customers
    e. Overseas parent requirement
    f. Facilitate compliance with HSE legislation
    g. Eliminate non-conformance results
    h. Improve HSE performance
    i. Thought it was good idea
    j. Benchmarking
8. Which of the following would be the most important sources for your company related to HSE matters?
    a. Publications, journals, books and papers
    b. Contact with relevant companies
    c. Visiting workshops/seminars/meetings

   d. Information received from NOC
   e. Contact with industry group
   f. Advice from parent / partner company
   g. Advice from consultant
   h. Advice from stakeholders
   i. Advice from insurance company
   j. Contact with leadership companies
   k. TV, radio media and newspapers and internet

9. Does your company monitor and measure its performance in relation to HSE?
   a. Yes
   b. No

10. Which of the following would be the most important motivators to encourage your company to use performance measures?
    a. To promote goods and services
    b. To monitor performance
    c. To communicate performance to stakeholders and interested parties
    d. To improve HSE

11. Which of the following learning activities are applied in your company regarding HSE matters?
    a. Accident investigation
    b. Near miss report
    c. Unsafe act and condition report
    d. Formal inspection
    e. Audit reporting and follow-up
    f. HSE meeting
    g. Enforcing safe job procedures
    h. HSE suggestions

12. What levels of the following persons are involved for the learning in your company?
    a. Top management and HSE committee
    b. Employees
    c. Supervisors and line management
    d. Stakeholders

Appendix D: Stage 3: Questionnaire

- **Critical**: Indicators perceived as critical and essential. The HSE management performance for the upstream, midstream, downstream and Oil field companies would end up as failure if these indicators do not exist in the company.
- **Important**: These indicators are considered as important but not essential (must) for the HSE management performance in the company. The performance process will survive if these are not addressed. However, the company may have trouble in terms of cost, avoidable delay or lost time and image.
- **Minor important**: These indicators will not seriously affect the success or failure of HSE management performance in the company.

No	HSE Indicators	Critical	Important	Minor important
1	HSE issues to be managed by company			
2	HSE policy to manage HSE enhancement			
3	HSE manual and procedure to manage HSE enhancement			
4	HSE committees to manage HSE enhancement			
5	HSE prizes to manage HSE enhancement			
6	Employees job analysis in terms of HSE to control its risks			
7	Risk assessment to control HSE risk			
8	Emergency planning to control HSE risk			
9	Personal protective equipment (PPE) to control HSE risks			
10	Work place ventilation system to control HSE risks			
11	Oil and gas upstream, midstream and downstream handling and labelling to control HSE risks			

12	To evaluate Incident management and accident record and investigation HSE performance			
13	Inspection and housekeeping to evaluate HSE performance			
14	Stakeholders attitude and perception surveys to evaluate HSE performance			
15	HSE housekeeping audit to evaluate HSE performance			
16	Awareness influence on effectiveness of company activity in HSE			
17	Financial losses to evaluate HSE			
18	Leadership commitment influence on effectiveness of company activity in HSE			
19	Management commitment influence on effectiveness of company activity in HSE			
20	Employees attitude influence on effectiveness of company HSE activities			
21	Employees participation influence on effectiveness of company HSE activities			
22	Documentation and HSE data control influence on effectiveness of company performance			
23	Internal HSE data communication influence on effectiveness of company			
24	Employees training influence on effectiveness of company HSE activities			
25	Financial resource allocation extent influence on effectiveness of company HSE activities			
26	Performances evaluation influence on effectiveness of company HSE activities			
27	Complying with regulations as motivator for HSE			
28	Expensive insurance cost of accidents and illness as de-motivator for HSE			
29	Providing safe work place for employees			

	as motivators for HSE			
30	Company publicity/image as motivator for HSE performance			
31	Pressure from regulatory authorities as motivator for enhanced HSE performance			
32	Pressure from employees as motivator for enhanced HSE performance			
33	Meeting requirements of customers as motivator for developing HSE performance review methodology			
34	Stakeholders as motivators for developing HSE performance review methodology			
35	Pressure from NOC and companies as motivators for developing enhanced HSE performance review methodology			
36	Good management procedures and tools as reasons for implementing HSE performance review methodology			
37	Competitive advantages as reasons of implementing HSE performance review methodology			
38	Required customers satisfaction as a reason for implementing HSE performance review methodology			
39	Facilitating compliance with HSE legislation reason for implementing HSE performance review methodology			
40	Improve HSE performance reason for implementing HSE performance review methodology			

41	Books as source for company on HSE performance review methodology matters			
42	Authorities source on HSE performance review methodology matters			
43	Attendance meetings, seminars source for company on developing HSE performance review methodology matters			
44	Information received from EGA source for company on HSE performance review methodology matters			
45	Advice from advisors important source for company on HSE performance review methodology matters			
46	Advice from insurance source for company on HSE performance review methodology matters			
47	Company should measure performance in relation to developing HSE performance review methodology			
48	Services motivator for using performance measure in developing HSE performance review methodology			
49	Monitor performance as motivator for using performance measures in developing HSE- PRM.			
50	Comply with EGA as motivator for using performance measures in developing HSE- PRM.			
51	Improve motivator for using performance measures in developing HSE- PRM.			
52	Communicate performance to interested parties as motivator for using performance measures in developing HSE- PRM.			

53	Group observation for HSE matters in developing HSE- PRM.			
54	Use unsafe act and condition report learning as activity for HSE matters in developing HSE- PRM.			
55	Use HSE meeting learning activity for HSE matters in developing HSE- PRM.			
56	Use group observation learning activity for HSE matters in developing HSE-PRM.			
57	Use enforcing safe job procedures as learning activity for HSE matters in developing HSE- PRM.			
58	Employees involved in learning exercise in company for developing HSE- PRM.			
59	Management involved in learning exercise in company for developing HSE-PRM.			
60	HSE committee involved in learning exercise in company in developing HSE-PRM.			

Appendix E: Libyan HSE framework

This section contains the provider's evaluation, with supporting evidence, of the health safety and environmental protection achievements, measured against the stated HSE standards. The evaluation should be set out in the structure provided by the six-aspects of health safety and environment as followed:

- Prevention
- Surveillance
- Response
- Achievements
- Resources
- HSE management and enhancement

The following notes are structured around these six aspects, and offer a set of prompts which are designed to ensure focused coverage of each aspect throughout the review and the associated report writing.

This is a guide to providers when drafting the self-assessment in line with NCSA project of UNDP in Libya, and is used by reviewers to guide:

- Analysis of self-assessment prior to the visit.
- Reviewing of evidence during the visit.
- Writing of the review report.

The key features and relationships for each aspect are covered broadly by this document. The HSE standards and the self-assessment from the framework for review:

1.1 Prevention

Questions	Y	N	N/A	Suggested Evidence/Examples	Action needed (for N or N/A responses)

Has the company formal mechanisms to ensure health safety and environment systems and procedures are reviewed regularly?				Internal audit plan/ audit trail, annual 'rolling programmed' of reviews.	
Does the health safety and environment policy contain a written statement of commitment to health safety and environment?				Statement of intent.	
Does the policy include the arrangements for health safety and environment?				Risk assessment records, consultation with workers, safe plant and equipment, safe handling, information, instruction, training, supervision, competency, etc.	
Is there a mechanism to collate/ report health safety and environment protection issue for inclusion in the review process?				Minutes of meeting, suggestion box, ISO 18000, TQM, etc.	
Is there a system in place to identify training needs?				Job descriptions, staff appraisal system, induction, risk assessment, etc.	
Are there controls for reviewing the effectiveness of the process for staff training for capacity building?				Course evaluation, etc.	
Are risk assessments regularly undertaken?				Risk assessment records, control measures, safe systems of work.	
Has a risk assessment in connection with fire risk been undertaken?				Fire risk assessment record.	
Are risk assessments regularly reviewed?				Review records, evidence of review on risk assessment records.	

1.2 Surveillance

Questions	Y	N	N/A	Suggested Evidence/Examples
Are the relevant Hazardous Substances regulations, Codes and Guidelines consulted and followed?				Monitoring records.
Are the health safety and environment surveillance procedures developed in consultation with employer and works?				Monitoring records.
Are examination and testing Procedures used for health safety and environment surveillance appropriate and adequate?				Monitoring records.
Is Interpretation of individual test results based on HSE Surveillance Guidelines?				Monitoring records.
Are discussions undertaken with a learner and the learner's supervisor?				Signatures of learner and supervisor on the monitoring record.
Is communication with employer and employees concerning health safety and environment surveillance demonstrated?				Monitoring records.

1.3 Response

Questions	Y	N	N/A	Suggested Evidence/Examples	Action needed (for N or N/A responses)
Have you allocated responsibilities for health safety and environment to specific people – are they clear on what they have to do and are they held accountable?				Company charts, job description, what you should know poster, etc.	
Do you consult and involve your staff and their representatives effectively?				Training, safety group membership, professional body etc.	
Do your staffs have sufficient information about the risks they				Monitoring, supervision, etc.	

run and preventive measures?					
Do you have the right levels of expertise? Are your employee properly trained?				Training, heath safety and environmental protection group membership, professional body, etc.	
Do you need specialist advice from outside and have you arranged to obtain it?				Occupational/ industrial experience, formal HSE Qualifications, IOSH/ NEBOSH qualified, etc.	

1.4 Achievements

Questions	**Y**	**N**	**N/A**	**Suggested Evidence/Examples**
Are the employer and employee involvement and communication essential on work place HSE issues?				Staff briefing instructions, on storage and maintenance
Do you analyse all work place conditions to identify and eliminate existing and potential hazards?				Action plans
Is the work evaluated on the basis of accurate job description?				Staff training records, job descriptions, etc.
Is there a mechanism to ensure correct use storage and replacement f PPE? Is it important for everyone in the work place to be properly trained?				Staff briefing instructions, on storage and maintenance Induction records, learner files, etc.
Is staff performance recognized and rewarded?				Staff training records, job descriptions, etc.

1.5 Resources

Questions	**Y**	**N**	**N/A**	**Suggested Evidence/Examples**
Does the company assign special resources to HSE activities on annual basis?				Workplace specific health and safety information etc.
Does the company obtain resources from				HSE booklets, provider's own HSE

HSE programs?				information etc.
Is necessary information disseminated to employees and others?				Induction records, learner files etc.
Does the company have a procedure to ensure that current legislative requirements are known?				HSE booklets, workplace specific HSE information etc.
Do the managers inform employees on the use of resource management information systems?				Provider's own HSE information etc.

1.6 HSE Management and Enhancement

Questions	**Y**	**N**	**N/A**	**Suggested Evidence/Examples**
Is there a mechanism to test enhancement of advance evaluation of conclusion plans?				Questionnaire quizzes, etc.
Is there system in place to ensure action/control measures are identified and taken where required?				Action plans (prioritization and time scale), inspection etc.
Is there mechanism in place to update health safety and environment management guidelines and issues?				Changes in prohibitions, activities, ongoing training/qualifications etc.
Do you have programs providing assistance to improve HSE Levels?				HSE booklets, provider's own HSE information,
Is there any cooperation with overseas country to improve HSE?				HSE booklets, provider's own HSE information, workplace specific HSE information etc.